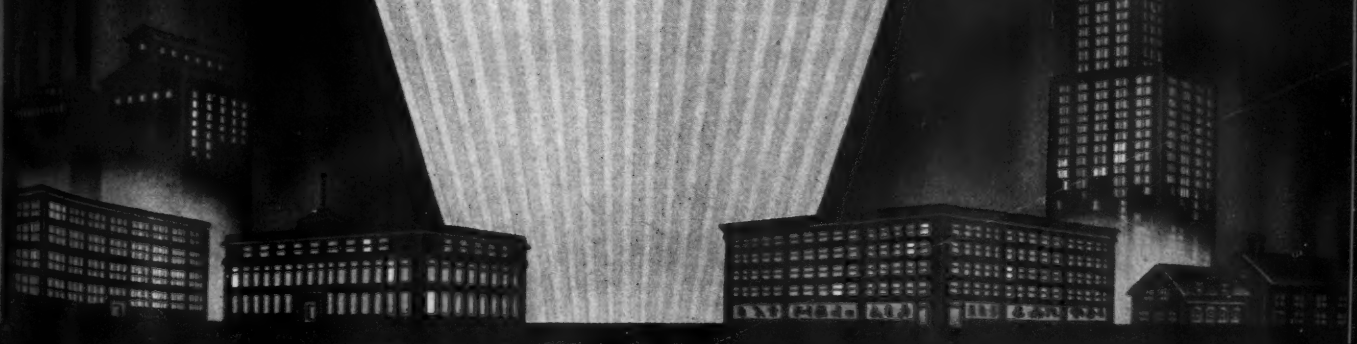
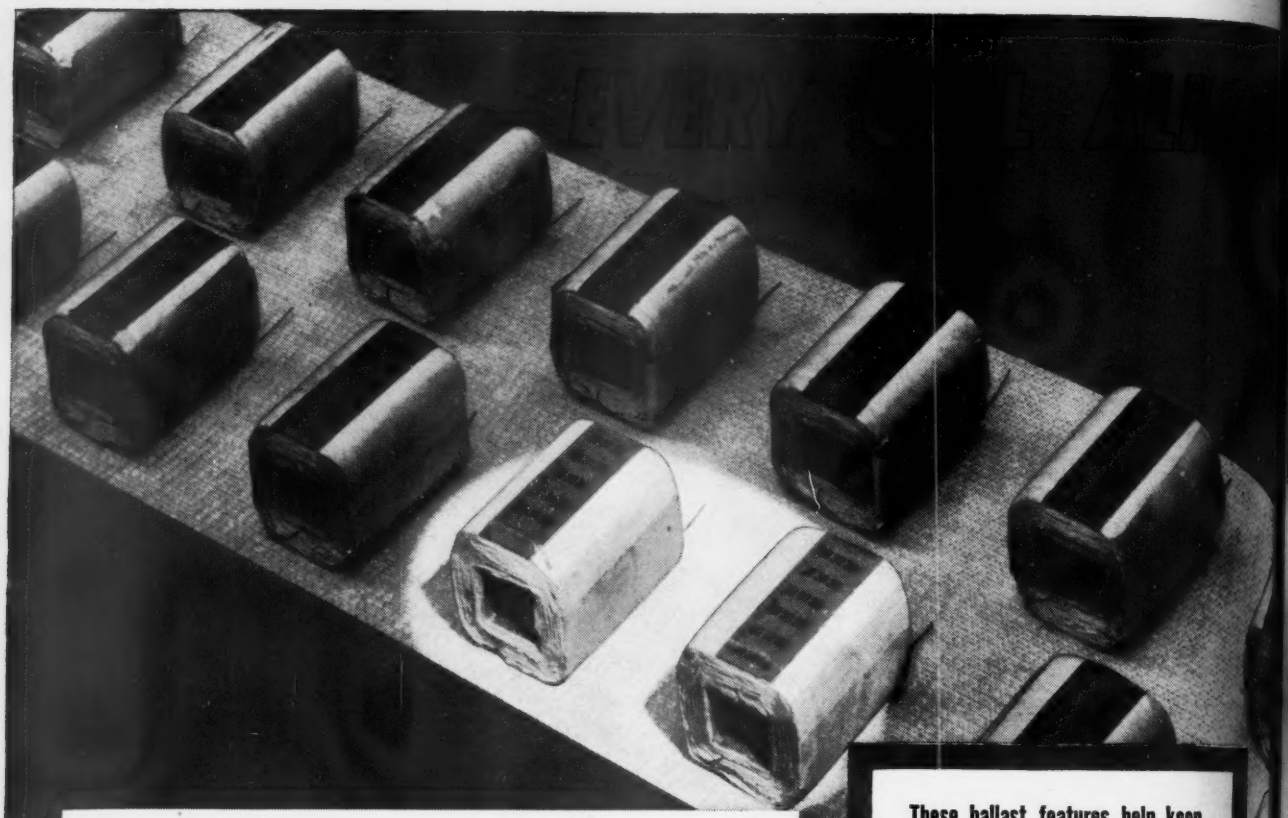
OCTOBER • 1945

Electrical Contracting

THE MAGAZINE OF ELECTRICAL CONSTRUCTION & MAINTENANCE

PLANNED LIGHTING





ANOTHER reason why G-E BALLASTS add reliability to your fluorescent fixtures

THESE ballast coils—picked at random from a production run—are identical. This is not a matter of chance.

These coils are automatically wound by a machine that predetermines the number of copper-wire turns for every coil layer, that spaces these turns exactly, and feeds in layer insulation at just the right instant. Constant tension is maintained on the coil wire as it feeds on to the specially constructed winding spool so that every finished coil is exact in size, smooth, compact, and evenly rectangular. No rounded sides, no "springy" layers.

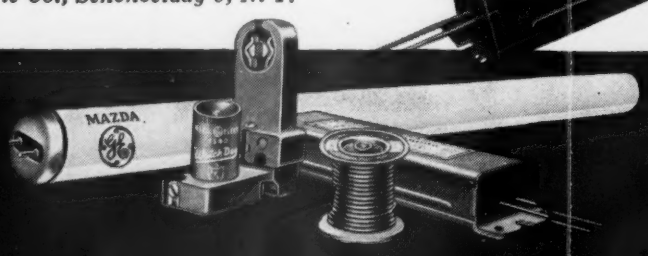
Long lamp life; rated light output. This uniformity of coil design is one important reason why every G-E ballast has electrical characteristics perfectly matched with the lamp it is to operate—a "must" to assure long lamp life and rated light output.

Improved ballast life. Matched characteristics contribute, also, to uniformly long ballast life—prevent early burnouts. It is features like this that are responsible for the fact that more than one billion watts of fluorescent lighting are being satisfactorily operated today with G-E ballasts. More than 150 lighting equipment manufacturers rely on G.E. for all or part of their ballast requirements.

For complete data on G-E ballasts, ask for GEA-3293F. *Apparatus Dept., General Electric Co., Schenectady 5, N. Y.*

These ballast features help keep fixture users satisfied—they mean added profits for you

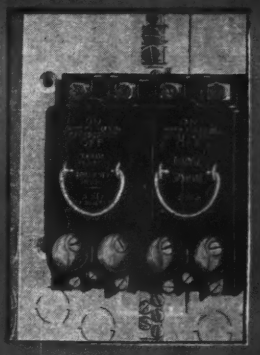
1. Low noise level—for satisfied users
2. Long life—for low replacement cost
3. Characteristics matched with lamp—for rated lamp life and light output
4. Dimensions that permit use of one wiring channel for practically all fixtures—for simplified parts inventory and lower fixture cost

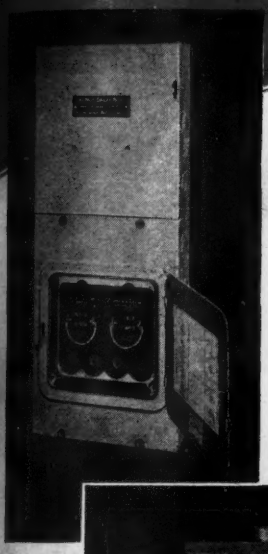


BALLASTS
LAMPS
STARTERS
LAMPHOLDERS
CABLE
for DEPENDABILITY in fluorescent lighting

Buy all the BONDS you can
—and keep all you buy

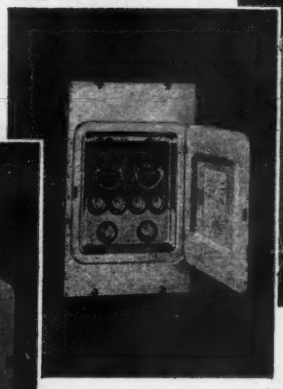
"What switch," say you? These "PULL-OUTS", say contractors!



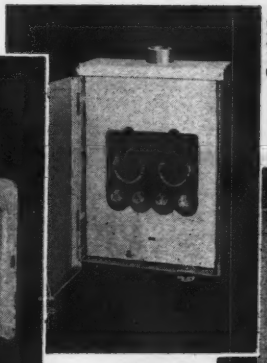


Cat. No. 258P
Metering equipment — Main and Range Switches.

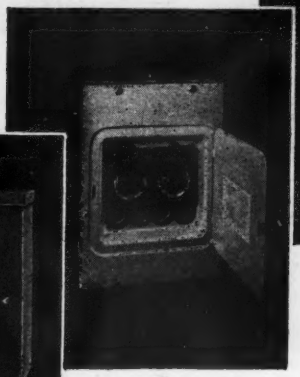
Cat. No. 74-6
60 amp. Main and Range Switches with 6 Circuits.



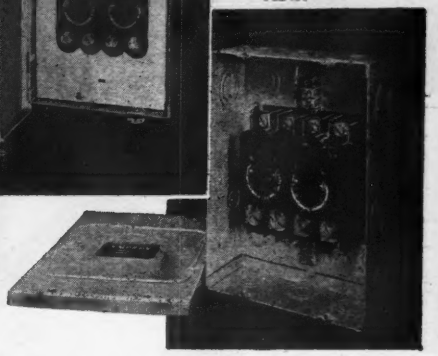
Cat. No. 52-4
60 amp. Outdoor Main and Range Switches with 4 Circuits.

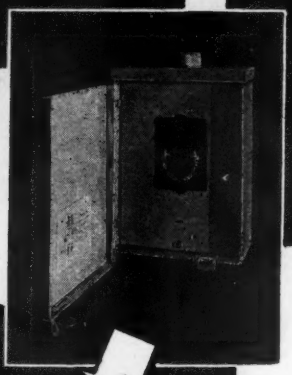


Cat. No. 74-4
60 amp. Main and Range Switch, with 4 Circuits.

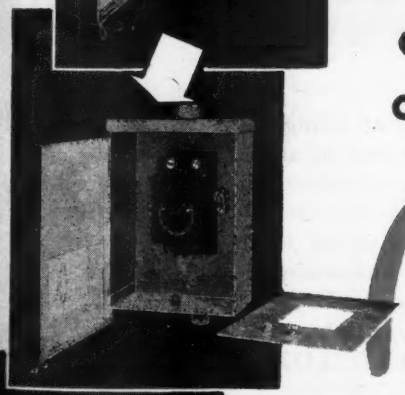


Cat. No. 74-4
Interior — Solderless Connectors in View.





Cat. No. 81
Outdoor — Service Switch — 60 amp.



Cat. No. 72
Main or Range Switch — 60 amp.

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Appleton Malleable Iron "Unilets" are stronger, yet lighter, than ordinary cast electrical fittings. Their perfect alignment and precision design give long rugged wear, make installation easy, economical. They'll last the life of the building—cost little to install and maintain!

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A practical technical and management journal for electrical contractors, industrial electricians, inspectors, engineers and motor shops, covering engineering, installation, repairing, maintenance and management in the field of electrical construction and maintenance.

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BULLETIN!

How to Take a Reconversion Inventory of Your Electric Motors

☛ As new manufacturing equipment becomes more widely available, and as you reconvert your production toward a peacetime basis, you may be faced with an unprecedented problem of inventory-taking.

☛ You may have to determine — more quickly than such a job has ever been done before — the exact condition of every piece of existing equipment you propose to use in peacetime production.

☛ For about four years, far greater emphasis has been placed on setting production records than on keeping maintenance records; condition of equipment is often unknown. Because much equipment has been worked during wartime three and four times as many hours a year as in peacetime, calendar age may mean nothing. And repair has often depended on American ingenuity and baling wire.

☛ Here are some of the standards you need to determine which of your electric motors: (1) are okay as is, (2) need repair or new parts, (3) will shortly require replacement, (4) need reapplication.

☛ These standards generally apply to all makes of motors; when in doubt on any motor, consult its manufacturer.

1 START YOUR INVENTORY WITH THE RECORDS

Begin your motor inventory with the history of each motor; you'll save much time and effort . . . you'll be guided quickly to the units which most need attention. Written records and the mental recollection of foremen and maintenance men are the source of this information.

Check the *master maintenance records* (though in most plants this file is out-of-date and incomplete, because of wartime pressure on production); and get *reports from foremen* (in a small plant, it may be possible to interview each man; in a large plant, it may be more efficient to distribute blank forms, such as the "MOTOR CHECK LIST" on opposite page.)

Look into the service to which the motor has been subjected in wartime: has it been overloaded? underloaded? worked 3 shifts daily? allowed to go to work in spray, steam, flood, acids? has it had mechanical injury? has it stood idle, collecting moisture and dirt?

Knowing the answers to these questions will help you spot motors that may soon give you trouble . . . you can start your inventory there.

NOTE: All new motors built during wartime, under WPB limitation orders, contain minimum amounts of critical materials. Thus, unlike many prewar motors, they have been incapable of withstanding continued overload operation in the way you've come to expect high-grade American motors to do. Moreover, you've had to take motors at the ratings you could get, without much regard to the exact requirements of the application. Thus, many motors have been running harder and at higher temperatures than nameplate ratings call for. Obvious result of this combination of factors is shortened insulation life. So—*expect* trouble where wartime motors are misapplied.

2 THEN CHECK MOTORS IN OPERATION

Obviously, the easiest and most practical measure of a motor's present condition is the way it is now operating. You can't learn all you need to know about its probable future performance by observing it in use, but a motor does reveal certain symptoms of trouble while doing its job.

Check the power line voltage and frequency and compare with the voltage and frequency of the motor as stated on the nameplate. To perform properly, a motor must be supplied from a line whose characteristics correspond with those for which the motor was designed.

Check rpm — hand revolution counter makes this easy. Just remove cap, hold counter against end of shaft, and take a timed reading; compare with nameplate rating.

Take temperature readings — not by the "blistered hand" or "touch and yell" system, but *accurately*, with *thermometers*.

Find the temperature of the *motor* by taping or cementing thermometer to the stator iron . . . take the reading, and add 15°C. (The difference between the heat on the outside surface and the possible heat of the hottest part inside).

Compare motor temperature with temperature rise rating on the nameplate. Normally a 40° rise is considered acceptable; top temperature usually should not exceed 80°C.

Take the temperature of *bearings*

either by taping or cementing thermometer to the bearing housing, or by inserting it into the oil well. In general, maximum safe bearing temperature is 96°C. (Bronze bearings may take somewhat higher temperature safely. When in doubt, consult motor manufacturer.)

Listen for — EXCESSIVE HUM. May be caused by uneven air gap, and may call for replacement of bearings. Or it may be caused by loose laminations or unbalanced rotor. Note this hum while inspecting motor in operation; check for cause later, while making inspection of parts.

Note — VIBRATION. If excessive, this may be caused by either misalignment between shafts of motor and driven machine, or through transmission of vibration in driven machine to the motor. Run motor disconnected for check. *If vibration follows motor repair,* it's probably due to out-of-balance rotor.

Listen for — RAPID KNOCKING. May be caused by misalignment, with shoulder of shaft pounding against bearing end; realign set . . . and note this knock, check bearings when making inspection of parts.

NOTE: if excessive vibration, knock, or squeal follows re-assembly of motor, cause may be incorrect axial adjustment for float.

Look for — EXCESSIVE SPARKING OF BRUSHES. Check for cause when motor is taken down for inspection.

3 THEN CHECK THE PARTS

If time permits, you'll want to give detailed inspection to *every* motor that's been in strenuous service these past years. (You may be able to work this into your regular production schedule. Set up a system so that the electrical department may be notified whenever a machine is to be down. Disassembly and inspection of motors can be done then.)

And in cases where *history* of the motor or its *operating characteristics* indicate the likelihood of present or future trouble, you'll surely want to take a close look at the parts themselves.

A. FIRST — disconnect motor leads and uncouple motor from driven unit.

B. THEN — if excessive hum was noted while motor was in operation, use feeler gauge to check air gaps between rotor and stator. Difference of more than 20% indicates overworn bearings, sleeves, or journals. Check bearings as indicated below.

C. REMOVE end housing and lift rotor out, using a sling if rotor weighs over 75 pounds. If rotor is dirty, clean it with air hose (pressure not over 30 lbs), bellows, or vacuum cleaner, or swab it with non-inflammable solvent.

D. INSPECT rotor for abrasion; corrosion; discoloration (caused by overheating.) In squirrel cage motor, check also for loose or broken rotor bars.

E. IF ROTOR or armature is the wound type, check for loose banding. If any looseness is noted, band with new wire before putting motor back in service. If band assembly has not failed extensively — perhaps only a solder failure at one or two clips — repair can usually be effected simply by resoldering. Major rebanding, however, is a job for experts.

F. CHECK INSULATION — As motors get older, or as they operate continuously at high temperatures, insulation on coils tends to become brittle. It may start flaking off, cutting its insulating value. This may not affect motor performance seriously *except* that it may lead to short circuits or grounds, excessive vibration (out-of-balance rotor), or clogging of the air vents (leading to overheating) or abrasive wear from fallen particles. SO — check insulation visually . . . see whether pieces of insulation have torn or flaked off . . . and also make a megger (megohmeter) test. For a clean, dry motor at 75°C, insulation resistance in megohms, according to the American Standards Association, may be found by the formula:

$$\frac{\text{Rated voltage of motor}}{\frac{\text{Rating in KVA}}{100} + 1000} = \text{Insulation Resistance in Megohms}$$

G. CHECK BEARINGS — to remove ball bearings, use a puller, applying pressure to the inner race only, maintaining uniform pull all around, to avoid distorting the bore of the race.

Check bearings for excessive wear, scoring, or pitting.

To examine *anti-friction bearings,* first clean them thoroughly with kerosene to remove all old grease and dirt particles; then hold inner race and rotate outer race, feeling for roughness of action and listening for noise.

Inspect sleeve bearing clearance with feeler gauge. Normal clearances may be computed this way: take 0.003" as the basic tolerance . . . then add 0.001" for each inch of shaft journal diameter. Inspect journal surfaces; if scoring seems excessive, consider replacing.

If bearing shows no excessive wear, the hum of the motor in action may result from out-of-balance rotor or armature. Check this on parallel bars.

H. CHECK for cause of sparking. Check mechanical condition of parts. (For details, see Reconversion Inventory Kit, offered below.)

4 NOW MAKE THE APPRAISAL

With all the facts in hand — history, operating characteristics, condition of parts — your electrical department will be best prepared to assign this motor to its new role in reconverted production. Use check list forms like this —

RECONVERSION INVENTORY CHECK LIST FOR ELECTRIC MOTORS

for easy inspecting and appraising. Your nearby Allis-Chalmers district office or distributor will supply free copies of this Check List in whatever quantity you require.

CENTRIFUGAL PUMPS, V-BELT DRIVES, NEED INVENTORY TOO!

To speed your Reconversion Inventory of the most common industrial units, Allis-Chalmers has prepared a Reconversion Inventory Kit covering Electric Motors, Centrifugal Pumps, and V-Belt Drives. No big package, this kit is simply a set of Fact Sheets and Check Lists covering each type of unit, with suggestions for inventory procedure as outlined in these pages, but in somewhat greater detail.

A 1901

GET THESE FREE FORMS

For your supply of Reconversion Inventory Kits, covering motors, pumps, and v-belt drives, call your nearest Allis-Chalmers district office or distributor or write Dept. 406, ALLIS-CHALMERS MFG. CO., MILWAUKEE 1, WIS.

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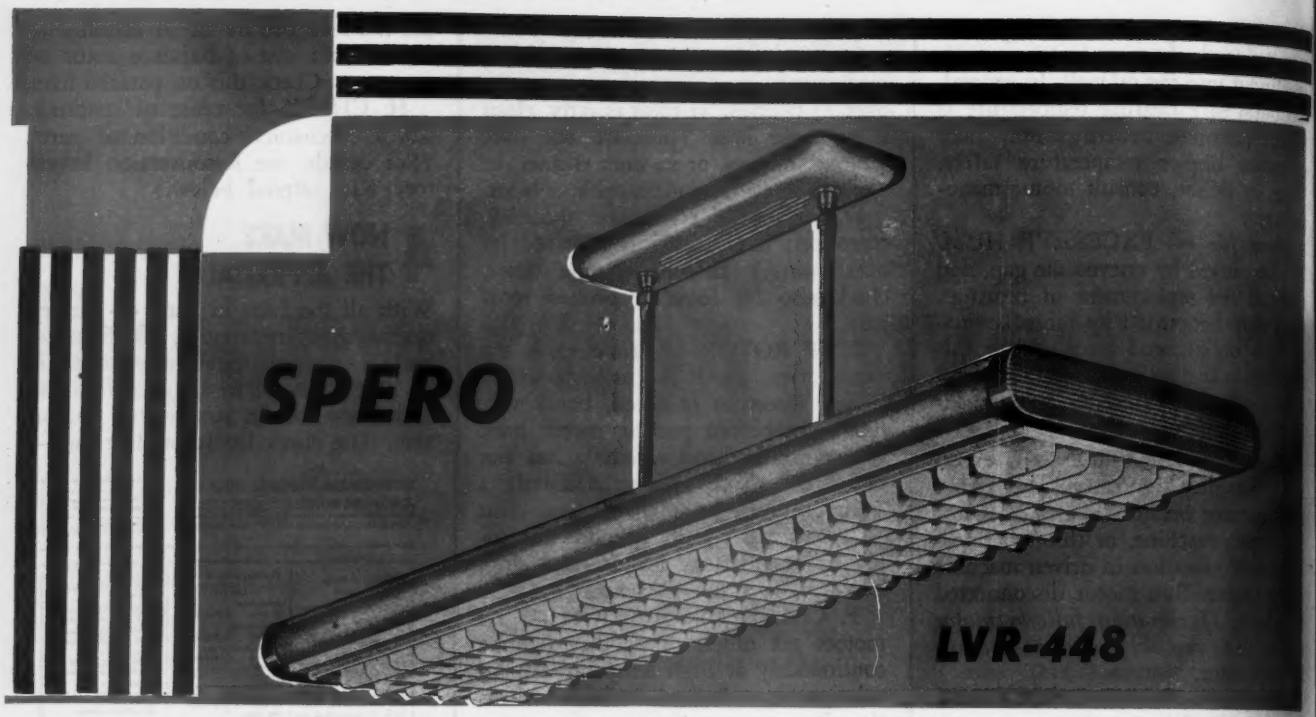


MASTERPIECE *of Fluorescent Engineering*

The Ideal commercial fixture - - combining highest efficiency, modern design, minimum glare and low maintenance costs

All the elements of correct design have been incorporated in this outstanding fixture. The light from the four 40W tubes is shielded by evenly-spaced egg-crate louvres, minimizing glare. Reflecting surfaces, finished in "Plastox" white (88% reflection factor) are so arranged as to eliminate "trapped light"—resulting in high intensity with low surface brightness. Plastic side panels shield end tubes and contribute to the smart streamlined appearance of this modern unit.

Made for stem or flush mounting. For stem mounting unit is equipped with an attractive ceiling canopy. Louvres are hinged for easy maintenance. Available with Spero Insta-ltie—providing instantaneous lighting and still further reducing maintenance costs by eliminating starting switches.

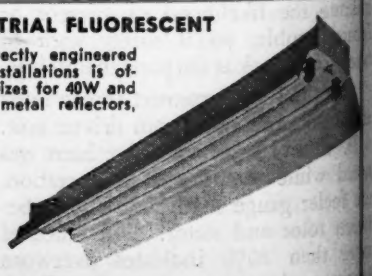
NOTE TO WHOLESALERS: Now is the time to become the distributor for this exceptional unit, the Spero LVR-448. Write for details.

THE SPERO PLANT STANDS BEHIND THE ELECTRICAL WHOLESALER

In spite of shortages and restrictions, Spero has continued to make and supply customers its regular line as far as possible. Spero products are sold only through legitimate electrical wholesalers.

SPERO INDUSTRIAL FLUORESCENT

A complete line of correctly engineered fixtures for Industrial Installations is offered in the Spero line. Sizes for 40W and 100W tubes. All have metal reflectors, with reflecting surfaces finished in "Plastox" white. Available with Insta-lite.

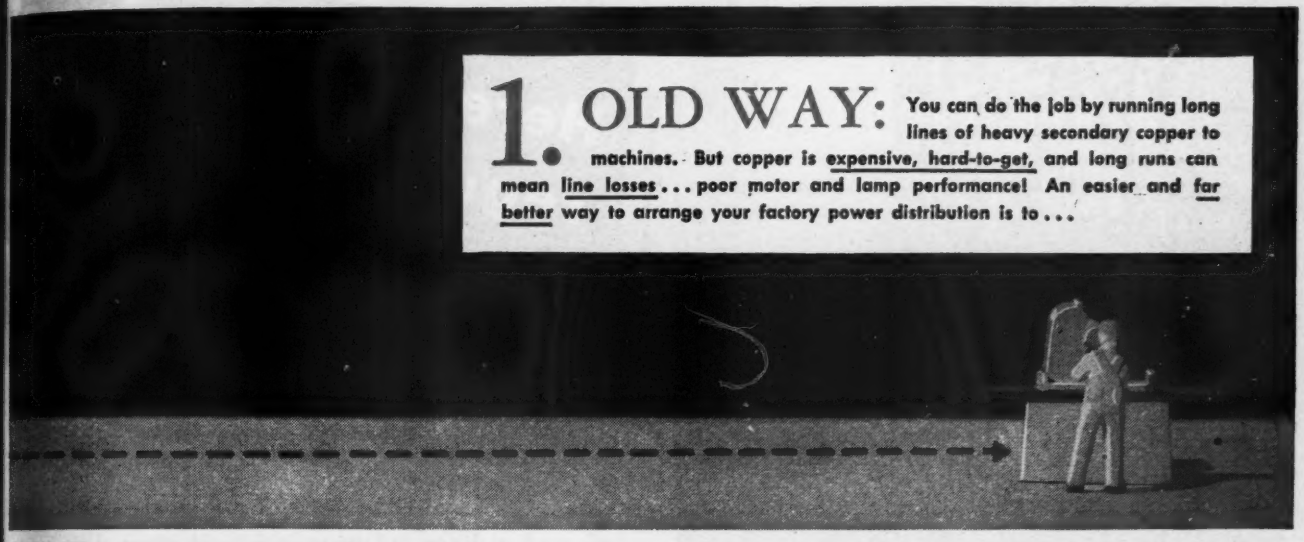


THE SPERO ELECTRIC CORPORATION

18222 LANKEN AVE. ★ CLEVELAND, OHIO

There are 2 ways

TO BRING POWER TO MACHINES. WHICH IS BEST?



1. OLD WAY: You can do the job by running long lines of heavy secondary copper to machines. But copper is expensive, hard-to-get, and long runs can mean line losses . . . poor motor and lamp performance! An easier and far better way to arrange your factory power distribution is to . . .

2. NEW WAY: Put your power right where you want it . . . the modern way! Yes, Allis-Chalmers Dry-Type Transformers can be installed right at load centers, next to the equipment they serve — stepping-up motor and lamp performance . . . saving you money, man-hours and materials!

HUNDREDS OF ELECTRICAL MEN who install and use Allis-Chalmers Dry-Type Transformers daily have *good reasons* for liking them! Here are a few:

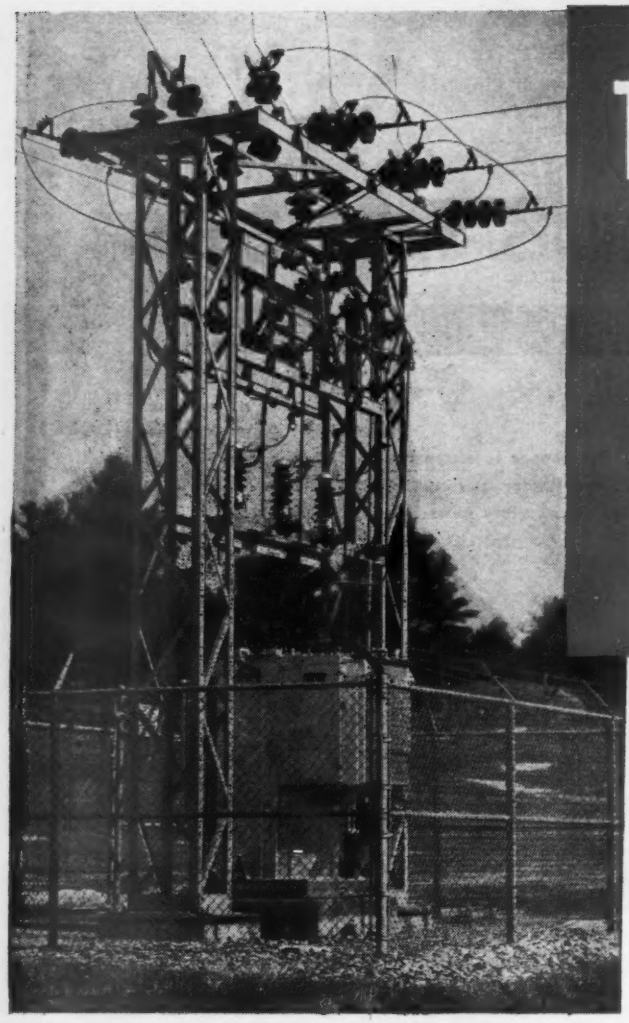
1) These units are small, lightweight, can't drip. Result: *they go up anywhere* — on posts, beams, overhead platforms. 2) They cut down on copper — *save money.* 3) They *step-up factory productiveness.* 4) They *take little maintenance* — have no insulating liquids to test, filter or change. Send for Bulletin B6027. ALLIS-CHALMERS, MILWAUKEE 1, WIS.

ALLIS-CHALMERS *Dry-Type Transformers*

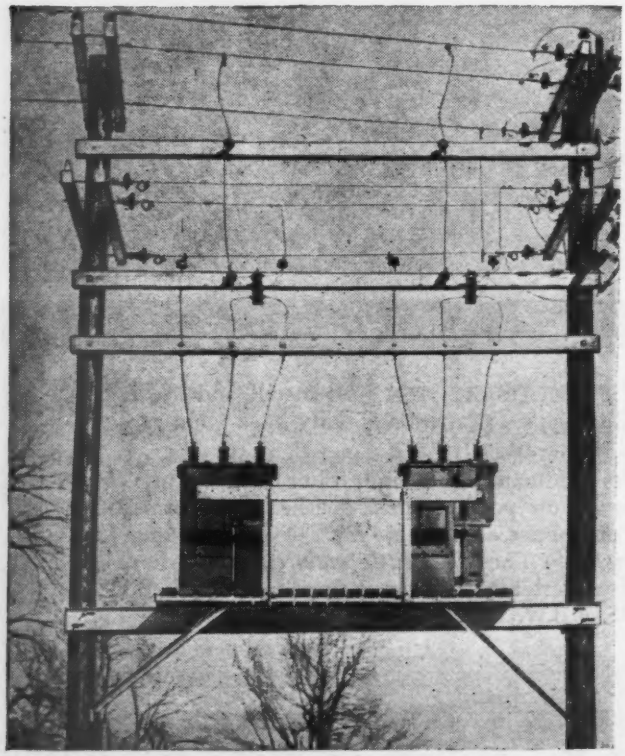
A 1831

The RIGHT VOLTAGE at the

Here's every type of regulator you need, to have the right voltage—anywhere



STEP REGULATORS (MLT-32)—For urban and rural circuits 69,000 volts and below. Provide 10% regulation raise and lower in thirty-two 5/8% steps. Ratings 104 to 750 kva, three-phase.



BRANCH STEP REGULATORS (ML-4)—For very low-cost regulation; 10% raise or lower in four 2½% steps on 2400-, 4800-, and 6900-volt feeders. Up to 51.8 kva, single-phase.

● It is now easy and inexpensive to extend the benefits of good voltage to every point of your distribution system—or to every nook and corner of your plant. Whether you need voltage regulation for urban feeders, rural lines, factory circuits, or laboratory, there is a simple, economical G-E device for the job.

A few ways these devices may be able to help you:

ON PRIMARY CIRCUITS

1. As an aid in maintaining service standards and keeping customer good will in the face of wartime distribution problems. Also, to iron out feeder-voltage problems.

2. To find "hidden kilowatts" (by releasing extra system capacity) without revamping present lines or adding new feeders. They're a "natural" for voltage problems that must be solved quickly. They make possible more effective use of equipment already on a system.

3. To make your system capacity more adaptable for postwar loads. Sudden shifts in population, drops in wartime loads or increased domestic and commercial loads can be taken care of more easily—often without changing generator or transmission facilities.

4. To reduce system costs. Actual case histories show annual savings of from $834 to $9950 on a single feeder.

ON SECONDARY CIRCUITS

1. For improved lighting (more constant light level); for better starting of fluorescent lighting; for increased lamp life;—by holding voltage at the proper level.

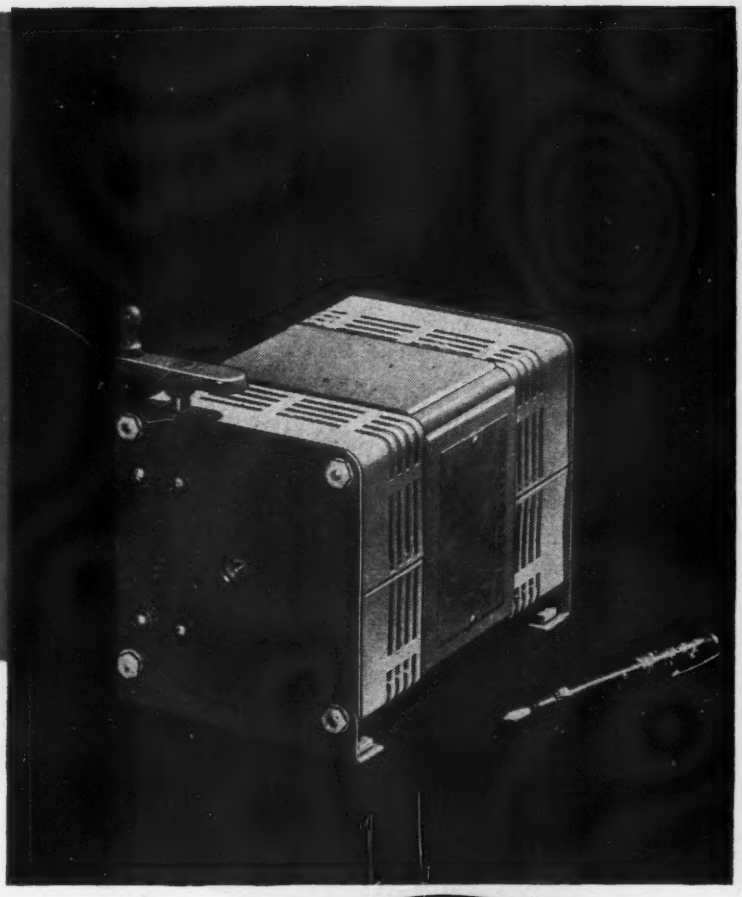
2. For greater production—by eliminating sluggish operation of motors and potential or control devices.

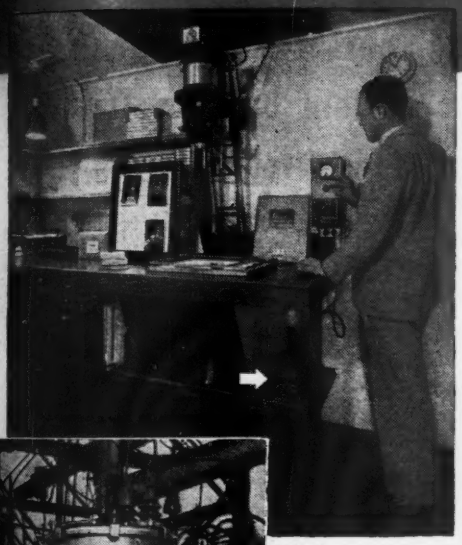
3. For longer life of electric equipment; for protection of precision electric devices, electronic tubes, etc;—by reducing overheating and burnouts.

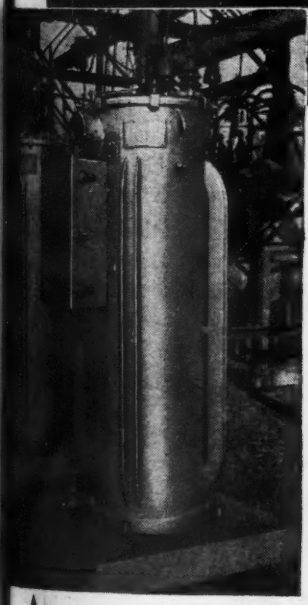
4. For the right voltage in your laboratory to assure accurate test results in less time.

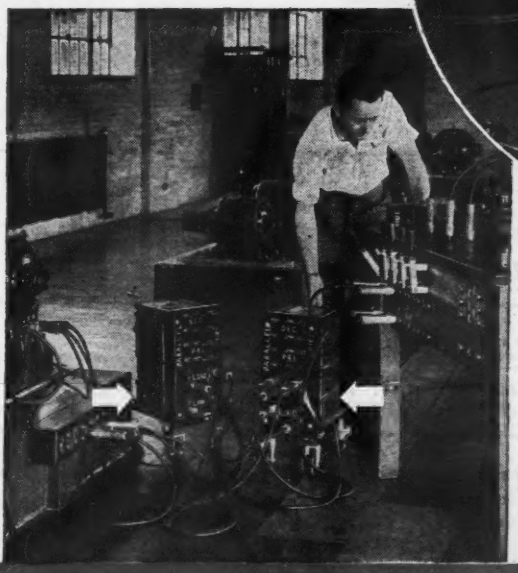
The regulators shown at work on these pages are only representative of the many G-E voltage-improvement devices that are available to help you. We shall be glad to help you analyze your voltage problem to determine what corrective measures are necessary. *General Electric Company, Schenectady 5, N. Y.*

the RIGHT PLACE Does the Job BETTER









SMALL DRY-TYPE REGULATORS—For 120- and 240-volt circuits. 10% raise and lower or 100% raise and lower regulation. Up to 600 va, single-phase. 10% ratings available for automatic operation.

VOLTAGE STABILIZERS—Automatically provide a constant 115- or 230-volt supply to a given load, on circuits varying from 95 to 130 or 190 to 260 volts. Ratings from 50- to 5000-va output.

VARIABLE-VOLTAGE AUTOTRANSFORMERS — Provide smooth, adjustable control of voltage, current, light, temperature, power, and speed at a turn of the dial. Ratings from 243- to 810-va output for 115- and 230-volt circuits.

INDUCTION REGULATORS (IRS —oil-type or Pyranol for indoor or outdoor use)—Provide 10% regulation raise and lower on 2400-, 4800-, and 6900-volt feeders. 12 to 120 kva, single-phase. Also available three-phase.

DRY-TYPE REGULATORS (AIRS)—For secondary circuits. *Automatic type:* Provides 10% regulation raise and lower. *Remote-motor or hand-operated:* 100% raise and lower. Up to 12 kva, 600 volts, single-phase. Also available three-phase.

GENERAL ELECTRIC

now your Big drives

NEW 2000-hp INDUCTION MOTOR LARGEST MEMBER OF TRI-CLAD FAMILY

Dwarfing the original Tri-Clad motor (resting on the conduit box) in size, this new 2000-hp "big brother" embodies all the same protective construction features.

It operates at 1800 rpm, on 2300 volts, 60 cycles. This new 3-phase motor is in the 6360-frame series, which is five steps larger than the largest standard industry frame size (namely 505).

*THE EXTRA

TRI/CLAD
REG. U.S. PAT. OFF.

Special motors can be custom built in Tri-Clad design for *your* problem

Your exceptional drive requirements may call for an induction motor specially designed to the job. Whatever its rating, it can generally be built with many of the Tri-Clad motor's strong points, such as enclosed upper portion, smooth cast-iron end shields, windings of Formex wire, and double-end ventilation.

General Electric's special motor engineering has produced the world's fastest motor, the world's strongest motor, and many other tradition-breaking designs. We'll welcome your unusual problems.

HERE'S TODAY'S WIDER RANGE OF STANDARD SIZES	
TRI/CLAD **Type K**	**1 hp to 2000 hp at 1800 rpm**
TRI/CLAD **Type KG** (High starting torque, low starting current)	**5 hp to 200 hp at 1800 rpm**
TRI/CLAD **Type KR** (High starting torque, high slip)	**Available to 100 hp in speeds required for high-slip flywheel drive (punch press, etc.)**

Buy all the BONDS you can—*and keep all you buy*

*can have it,** *too*

PROTECTION OF CONSTRUCTION

G-E STANDARD Tri-Clad Induction Motors Now Available to 2000 hp

For that important *big* drive (up to 2000 hp, 1800 rpm) you can now get a G-E standard Tri-Clad induction motor. All the protective features that have proved so valuable to service continuity and long life in the more widely used sizes are included:

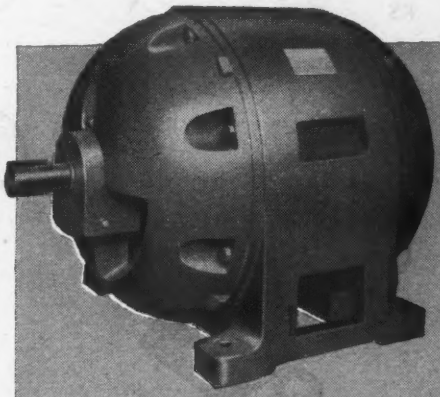
EXTRA PROTECTION FROM PHYSICAL DAMAGE—Cast-iron construction with upper portion completely enclosed to keep out falling objects, dripping liquids. Streamline, cast-iron end shields. Corrosion-resisting finish.

EXTRA PROTECTION FROM ELECTRICAL BREAK-DOWN—Windings of Formex* wire are solidly bonded with synthetic resins strongly resistant to heat, oil, and moisture. Formex wire insulation stands up strongly under abrasion or "heat-shock."

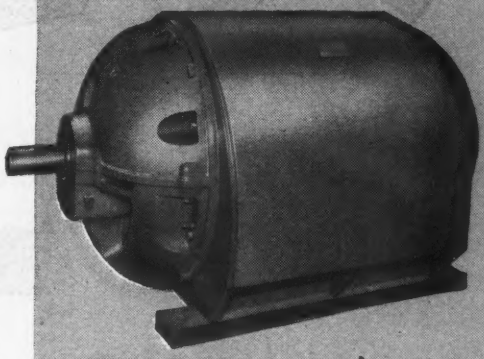
EXTRA PROTECTION FROM OPERATING WEAR AND TEAR—Available with either sleeve or ball bearings—in dust-tight housings. Sleeve-bearing design is a further refinement of well-proved Tri-Clad motor bearing proportions, efficiently lubricated, with "air seal" to insure oil tightness of the housing.

The Tri-Clad, in its wide range of types and sizes, is G.E.'s most widely used (integral-hp) motor. Chances are that there's a Tri-Clad to meet your requirements "on the nose." For information on General Electric's complete line of Tri-Clad motors, ask for GEA-3580. *General Electric Company, Schenectady 5, N. Y.*

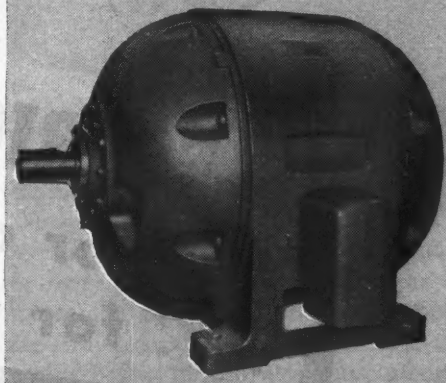
*Trade-mark reg. U.S. Pat. Off.



Typical large-size sleeve-bearing Tri-Clad polyphase motor, now standard up to 2000 horsepower.



Modified cast-iron frame construction used for certain large sizes of the extended Tri-Clad motor line.



Separable housing construction used for large-size ball- or roller-bearing Tri-Clad motors. Roller bearings are standard at coupling end.

GENERAL ELECTRIC

ELECTRICAL CONNECTORS

. . . for quick repairs
. . . for permanent re-wiring

For speedy repairs or efficient, low-cost rebuilding . . . Burndy can fill every requirement for electrical connectors. All are designed for simple, speedy installation . . . all *long proved* for their efficiency and permanency. Let us know your requirements. Literature, and engineering cooperation, freely offered. Burndy Engineering Co., Inc., 107-D Bruckner Blvd., New York 54, N. Y.

Headquarters for CONNECTORS

Burndy

IN CANADA: Canadian Line Materials, Limited, Toronto 13

Mister, now's the time to figure on

Horsepower by Howell

The Howell Protected Type Motor, shown, gives complete protection against dripping liquids, metal chips and other falling particles. Completely streamlined—utilizing non-breakable steel frame—malleable or steel base—cast iron end plates and cast iron, weatherproof terminal box are standard construction features. Special horizontal and vertical mountings are available. *Available in sizes 5 H.P. and smaller. Other sizes and types available up to 150 H.P.*

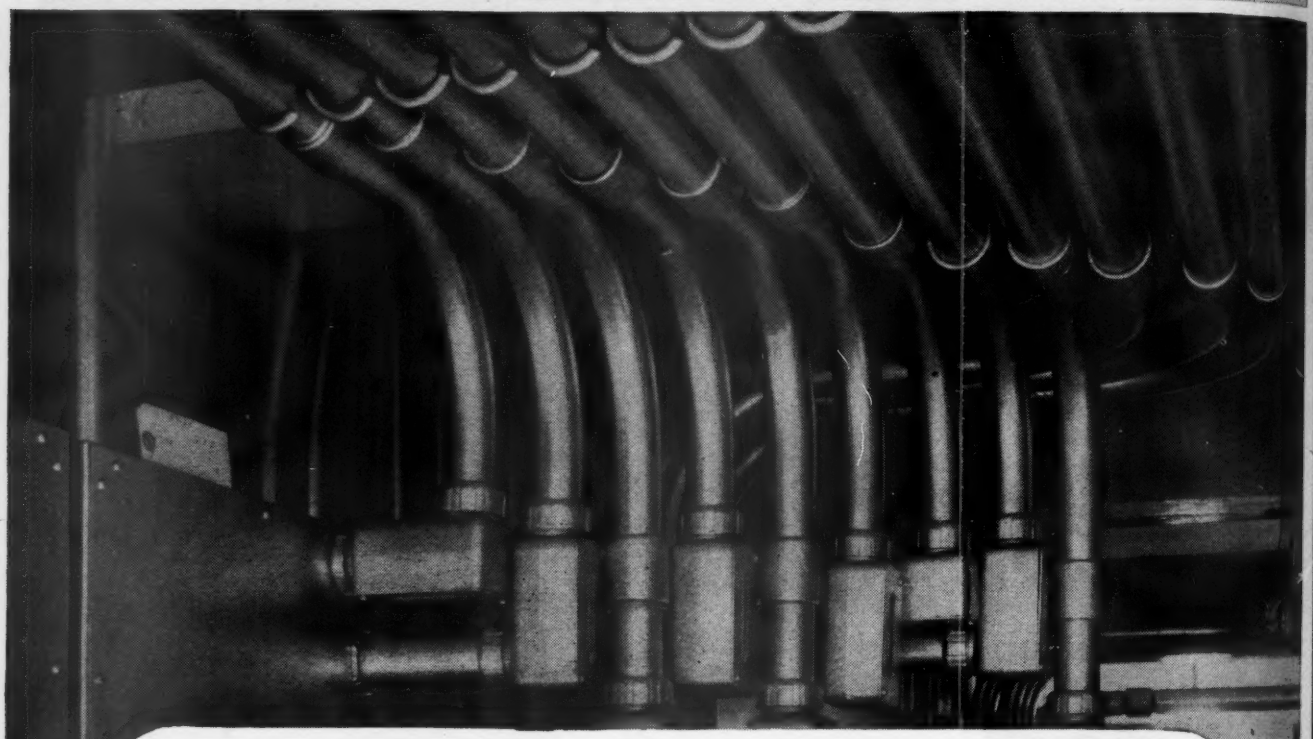
Years of building Howell Motors, to meet the exacting requirements of the automotive, dairy, food and other important industries, have enabled us to make them better than ever. Today, as always, Howell Motors are quality-motors. They are quiet-operating because they are statically and dynamically balanced. They are better performing because they are built of the finest materials—copper or bronze rotors—and completely insulated. They are trouble-free on the job because they are designed for the toughest tasks in industry—consequently, they perform better on all jobs. For your postwar need in specialized or standard motors, from ¼ to 150 h.p., phone the nearest Howell Representative today.

HOWELL ELECTRIC MOTORS COMPANY

HOWELL, MICHIGAN

Manufacturers of Quality Motors Since 1915

FOR SAFETY'S SAKE . . . USE CONDUIT (*Full Weight Rigid Steel*)



Smart Post-War Planning Demands SAFE Wiring Methods

A double responsibility confronts the electrical industry:

1. The obligation to replace makeshift, unsafe wiring systems, installed according to "must do" emergency ideas, forced on industry by war time shortages and regulations.
2. The duty to install only assuredly safe wiring systems in all new post V-Day construction.

Remember this: The only wiring system approved by the National Electrical Code as moisture, vapor, dust and explosion proof in hazardous locations is a standard-threaded rigid conduit.

With standard-threaded rigid steel conduit, such as Youngstown's Buckeye, again available through distributors, there is no reason not to provide dependable wiring protection.

Wherever there is moisture, or vapor, or excessive vibration, or possibility of corrosion, or accumulating dust and dirt, or danger of crushing or other mechanical injury, specify and use Youngstown Buckeye Conduit.

YOUNGSTOWN

THE YOUNGSTOWN SHEET AND TUBE COMPANY

YOUNGSTOWN, OHIO

Manufacturers of

CARBON - ALLOY AND YOLOY STEELS

Ask your distributor for:
Youngstown Buckeye Conduit - Pipe and Tubular Products - Sheets - Plates - Electrolytic Tin Plate - Coke Tin Plate - Bars - Rods - Wire - Nails - Tie Plates and Spikes

What A Rough Four Years

...And before we could take a deep breath, we were given another challenge—adapting *without delay* new developments, new techniques to civilian uses.

We like to think of our wires and cables as we think of the veterans now returning to civilian life. These veterans will not be the same people we sent off to war. They are battle-tested—they have grown up—they are ready to take on greater responsibilities than before.

Our wires and cables, too, are ready to take on new responsibilities. They have had to do jobs tougher than any wire ever faced . . . wherever the war took them—and it took them everywhere . . . moist, steaming jungle to bleak, frozen wastes. Whatever the conditions and demands—they came through the better for them.

What does this mean to the Electrical Contractor? Just this—we have come back with a complete line of Industrial, Commercial and Residential wires and cables that are better than ever, including the new smallest diameter, lightest-weight, rubber-covered building wire ever developed.

Yes, it was a tough four years . . . we learned a lot . . . and now our new knowledge belongs to you.

U. S. ELECTRICAL WIRES AND CABLES

Serving Through Science

UNITED STATES RUBBER COMPANY

1230 SIXTH AVENUE • ROCKEFELLER CENTER • NEW YORK 20, N. Y.

WHY- Standard TRADE MARK DRY TYPE TRANSFORMERS

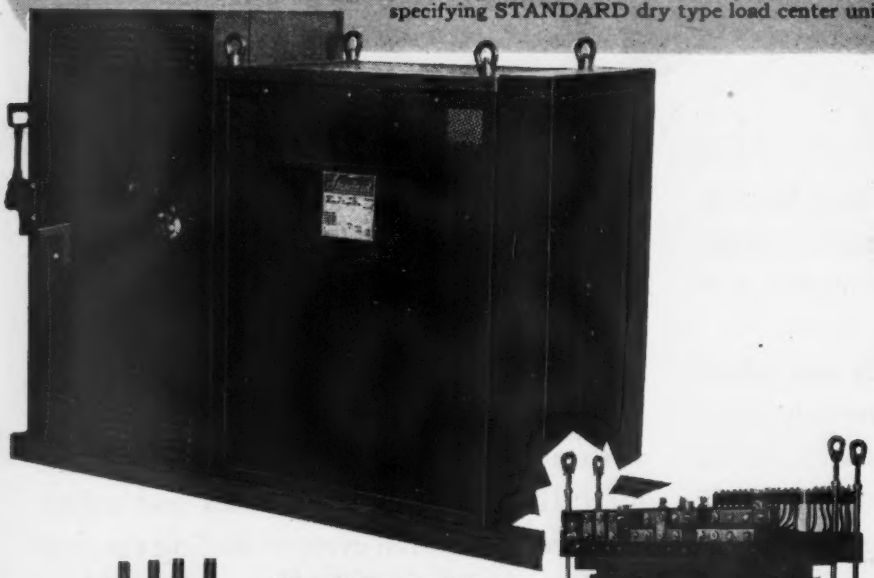
Save Money and Manhours FOR YOU

★ Installed at POWER LOAD CENTERS

Dry Type, air cooled transformers, combined with protective equipment, result in economy and efficiency for indoor distribution systems. Specialization in transformer design coupled with 25 years' experience make STANDARD a dependable source for consultation as well as transformer production. Here's how you'll benefit by specifying STANDARD dry type load center units:

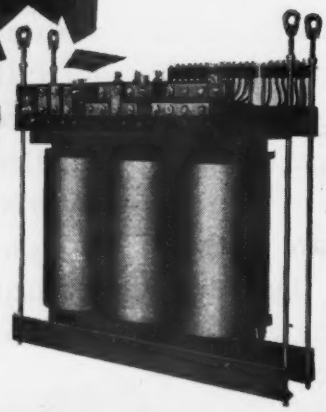
1. save MATERIALS . . . less copper less steel by locating at load center.
2. save LABOR . . . order transformers with switches, breakers or fuses combined in one unit.
3. save SPACE . . . easily installed above the floor or in out-of-the-way locations to conserve floor space. No fireproof vaults needed.
4. save ON MAINTENANCE . . . no liquids to test or filter on dry type transformers.
5. save ON FIRST COST . . . since no extra engineering and less labor costs are involved in fabricating unit substations.
6. increase EFFICIENCY of motors by supplying full voltage.
7. increase EFFICIENCY of lighting —eliminate flicker and get full illumination by supplying full voltage.
8. increase TRANSFORMER CAPACITY through use of Class B insulation (fiberglas and similar inorganic materials) which permits greater intermittent overload capacity.
9. increase FLEXIBILITY of system, since transformer and attached equipment may be easily relocated when necessitated by changes or moves in production equipment.

Standard Engineered and built Dry Type Power Load Centers provide all of the above plus permitting the user choice of make, type, and arrangement of accessory equipment.



Unit substation, consisting of attached high voltage disconnect switch and fuses, low voltage enclosed circuit breaker panel and dry type air cooled 600 KVA transformer. H-beam base construction permits portability. Suitable for platform mounting in large industrial building.

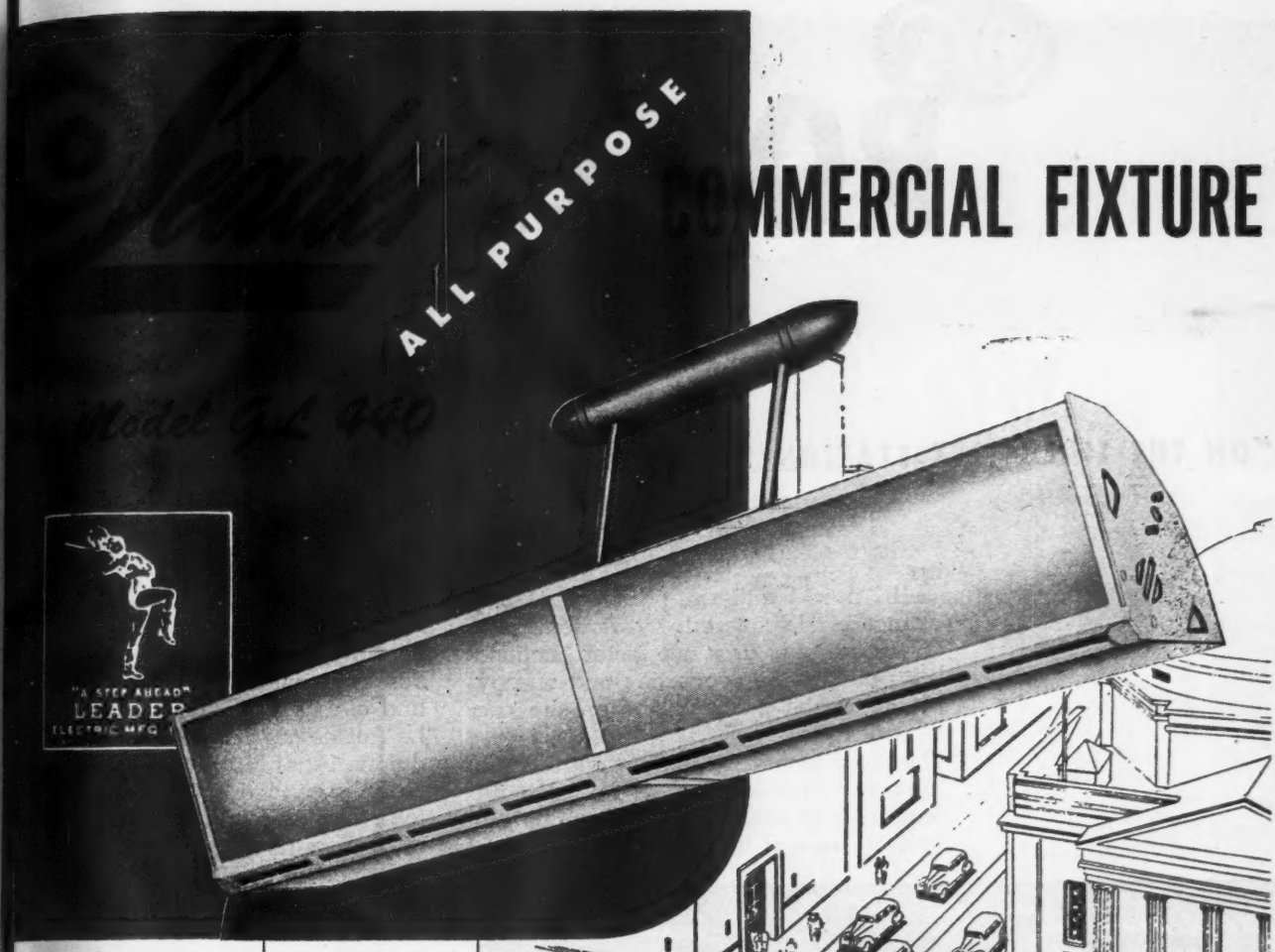
Twenty-five KVA, single phase, 2400 volt air cooled unit with attached oil fuse disconnects, arranged for platform mounting.



Core and coil structure of this class B insulated (for 80°C temperature rise) transformer. STANDARD makes full use of the newest in transformer insulating materials.

FOR EVERY CLASS OF Service

THE STANDARD TRANSFORMER CO.
WARREN, OHIO
THE SPECIALISTS IN TRANSFORMER DESIGN FOR OVER 25 YEARS



COMMERCIAL FIXTURE

a fluorescent fixture for *Main Street*

Designed for offices, stores, institutions ... from Main Street to Broadway.

The Leader GL 440 is adaptable to a wide variety of installations, particularly, offices, drafting rooms, schools, stores, banks and other institutions.

A four light glass enclosed unit with a simple concise design, the Leader GL 440 lends itself to modern trends in architecture and lighting.

A hinged panel with snap fasteners is provided to facilitate relamping and servicing. Easy to install either in individual or in continuous run, flush mounted or hung from stems and canopies.

Distributed only through the better electrical wholesalers.

★ post war lighting *Now!*

There is a Leader representative in your area

Leader Electric Manufacturers Corp.

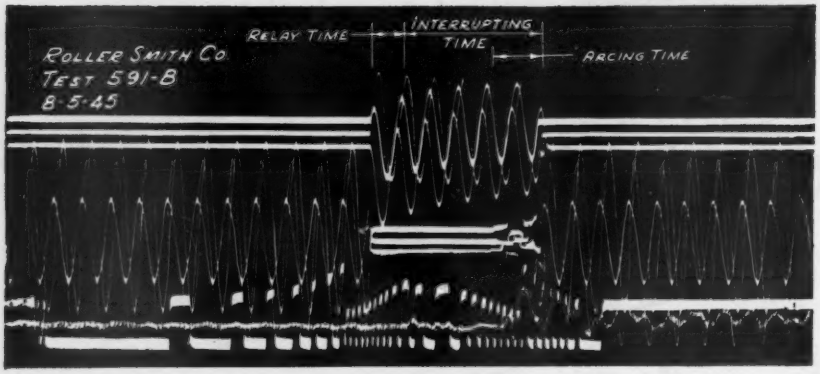
6127 North Broadway, Chicago 40, Illinois
West Coast Factory:
2040 Livingston Street • Oakland 6, California

ROLLER SMITH

"ON THE LINE" TEST STATION PROVIDES KEY TO SECRETS OF ARC EXTINCTION

THE new Exotherm principle of arc extinction discovered by Roller-Smith engineers puts arcs out faster because it harnesses the properties and energy of the gases produced when the arc is struck.

The discovery of the Exotherm principle grew out of the efforts of Roller-Smith engineers to reconcile conventional laboratory tests of breakers with performance "On the Line." The only answer seemed to be "On the Line Testing" of breakers. Through cooperation of the utility industry the first "On the Line" test station of its kind was established by Roller-Smith to seek out the real facts about oil circuit breaker performance. Because the tests were conducted under actual operating conditions, the full value of recovery voltage, both normal and transient, came into play. For the first time conflicting theories and claims about arc extinction could be tested under actual service conditions. After hundreds of tests "On the Line," provided information never before available, the Exotherm principle of arc extinction was discovered. A chamber in which the arcing takes place confines the gas, compresses it, and correlates the thermal and pressure characteristics to obtain rapid arc extinction.



Typical test oscillogram of Roller-Smith oil circuit breaker employing Exotherm principle. Note 5 cycle interrupting time.

Roller-Smith oil circuit breakers with the Exotherm principle give consistent 5 cycle operation; little or no burning of contacts and low pressures inside the tank. 5 cycle operation means better protection to equipment with resulting savings. Making use of the arc energy results in less contact burning and less oil sludging, saves inspection and maintenance. Low tank pressure results from the Exotherm principle because the gas is cooled and contracted before it gets into the tank. The result —far greater safety for indoor operation than ever before.

For full information on the Exotherm principle applied to Roller-Smith oil circuit breakers, write to dept. EC.

ROLLER SMITH

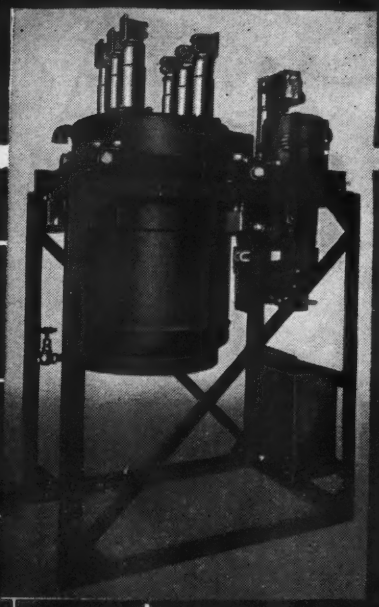
Oil Circuit Breakers

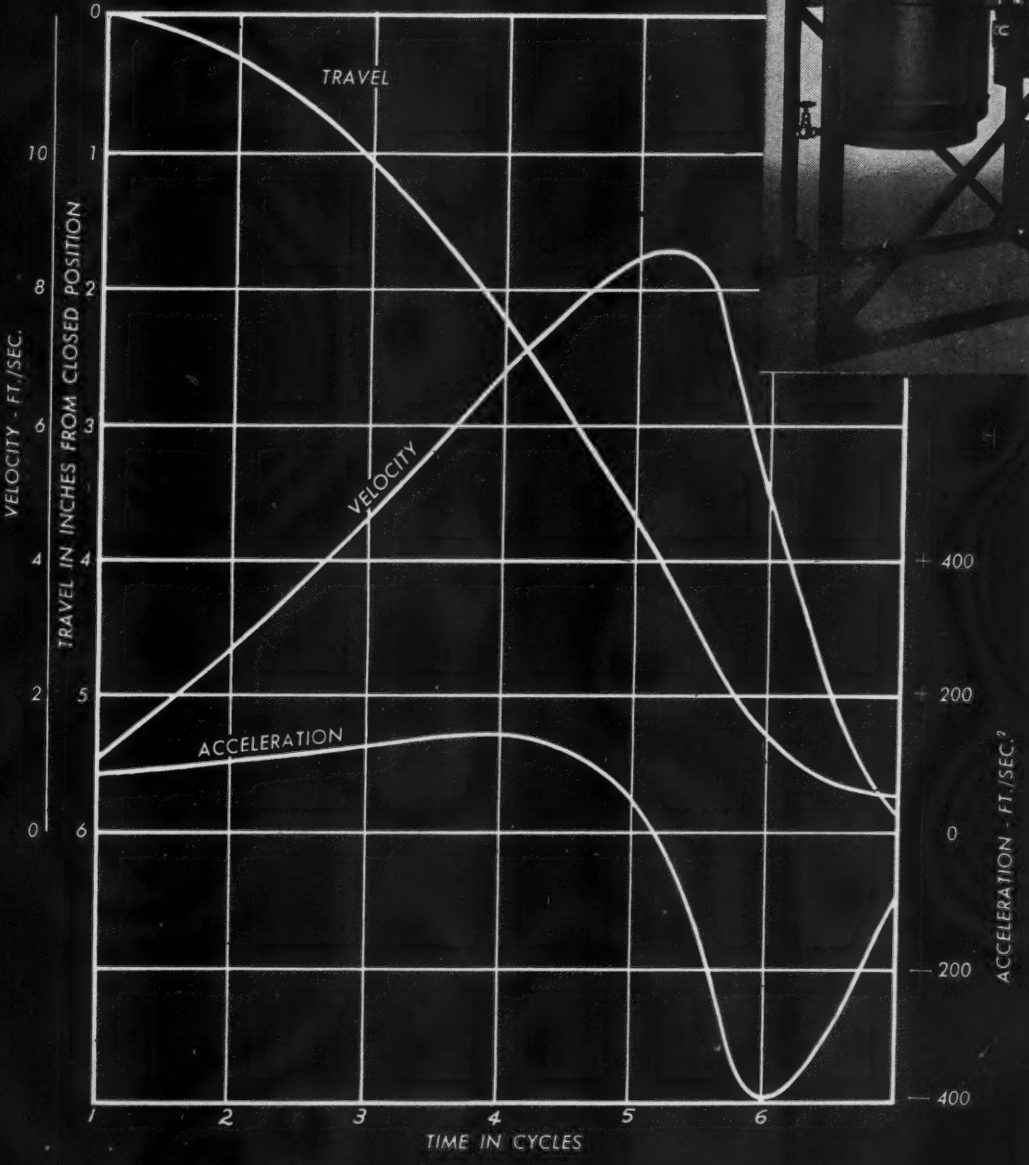
BETHLEHEM • PENNSYLVANIA

In Canada: Roller-Smith Marsland, Ltd., Kitchener, Ontario

STANDARD AND PRECISION ELECTRICAL INSTRUMENTS • AIRCRAFT INSTRUMENTS • SWITCHGEAR
AIR AND OIL CIRCUIT BREAKERS • ROTARY SWITCHES • RELAYS • PRECISION BALANCES

Announces




TRAVEL
VELOCITY
ACCELERATION
VELOCITY - FT./SEC.
TRAVEL IN INCHES FROM CLOSED POSITION
ACCELERATION - FT./SEC.²
TIME IN CYCLES
0
2
4
6
8
10
1
2
3
4
5
6
+ 400
+ 200
0
— 200
— 400

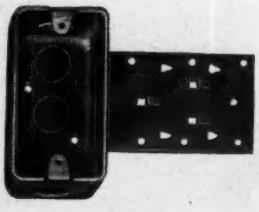
Builders, Contractors, and Architects the country over know that Raco is the famous name of All-Steel-Equip's quality line of steel switch boxes and outlet boxes. And you also can always rely on Raco. Here's why:

- No jagged or rough edges—no dirt or grease. Smooth, attractive appearance!
- Every Raco product comes neatly packed in a protective carton . . . with index showing number, quantity and finish. Easy to stock . . . easy to identify.
- All-Steel has been making precision metal products for over 33 years. The Raco line is made with the same care—to the same exacting standards!

Write today. Let us tell you more about Raco • All-Steel • Products . . . it's the dependable line, the uniform line, the line that's sold nationally through wholesalers only.

←400½-O—STANDARD (UTILITY) BOX. *With "Side-Mount" Bracket. Enameled or galvanized finish.*

400½-B—STANDARD (UTILITY) BOX. *With "Face-Mount" Bracket. Enameled or galvanized finish.*→



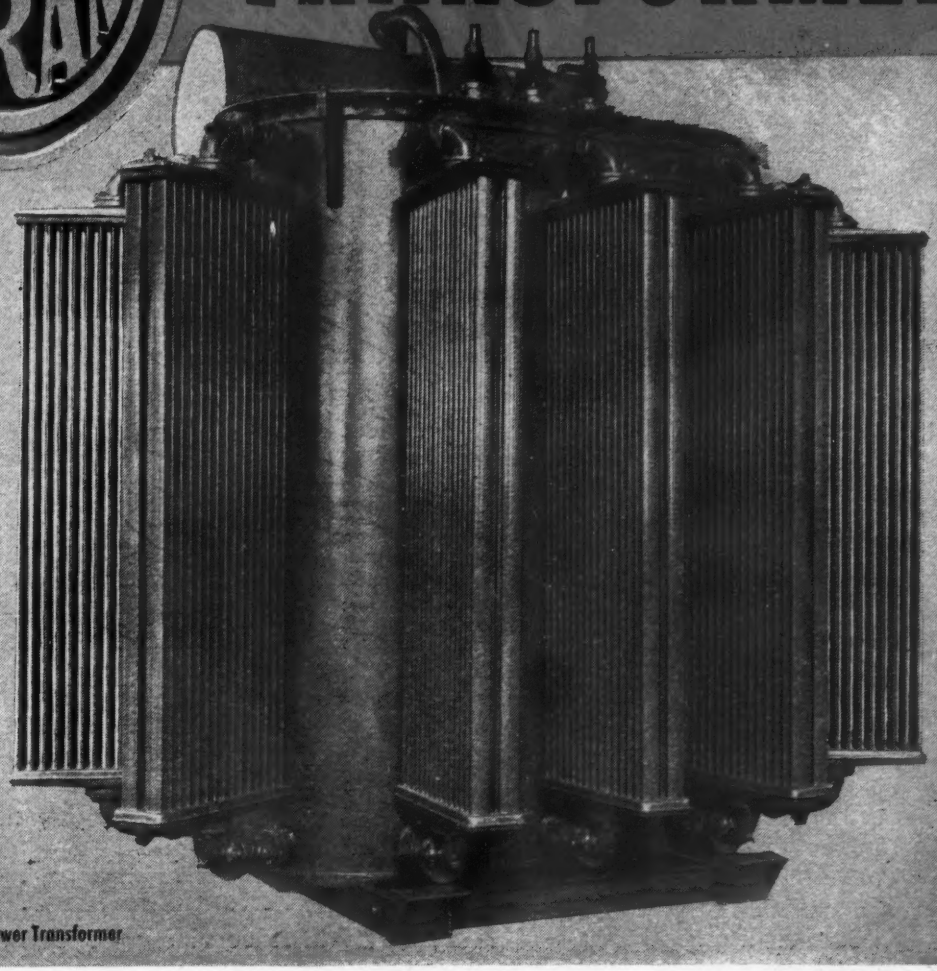
ALL-STEEL-EQUIP COMPANY, INC.
600 Kensington Avenue, Aurora, Illinois

RACO • ALL-STEEL • PRODUCTS
SWITCH BOXES • OUTLET BOXES

AMER TRAN

tailored

TRANSFORMERS



3,300 KVA, Single Phase, Power Transformer

AmerTran's concentrated experience in building *tailored* transformers reduces trial and error. This provides a sound solution to your individual and unusual problems.

This specialization also gives you the latest in transformer design. It is the keystone of AmerTran's forty-four years of progress in transformer manufacture. A letter outlining your problem may mean solving it.

AMERICAN TRANSFORMER COMPANY

178 EMMET STREET, NEWARK 5, N. J.

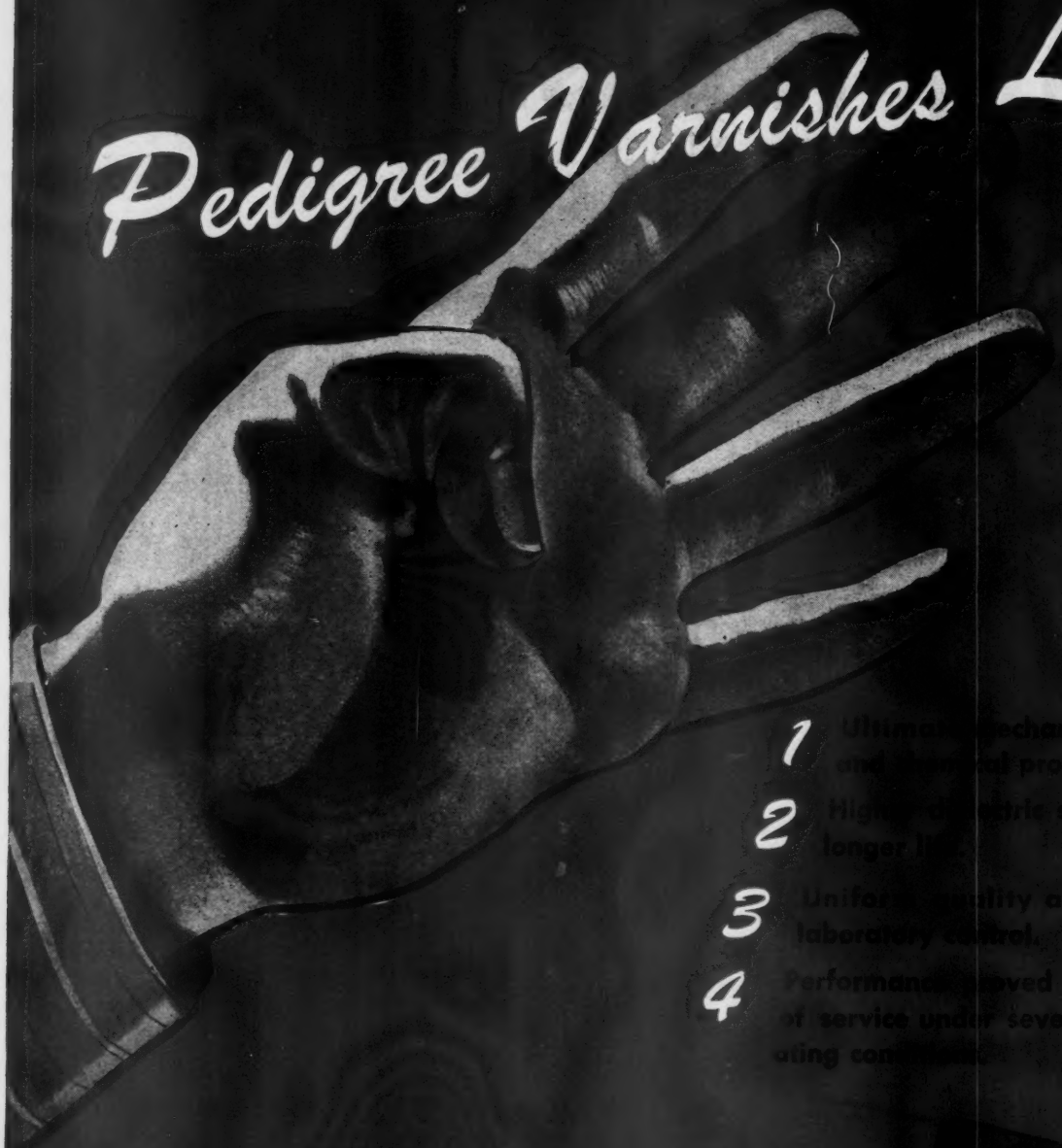
AMERTRAN

MANUFACTURING SINCE 1901 AT NEWARK, N. J.

Pioneer Manufacturers of Transformers, Reactors and Rectifiers for Electronics and Power Transmission

AMER TRAN

Pedigree Varnishes Lead



1 Ultimate mechanical, thermal and chemical protection.

2 Higher dielectric strength and longer life.

3 Uniform quality assured by laboratory control.

4 Performance proved by years of service under severe operating conditions.

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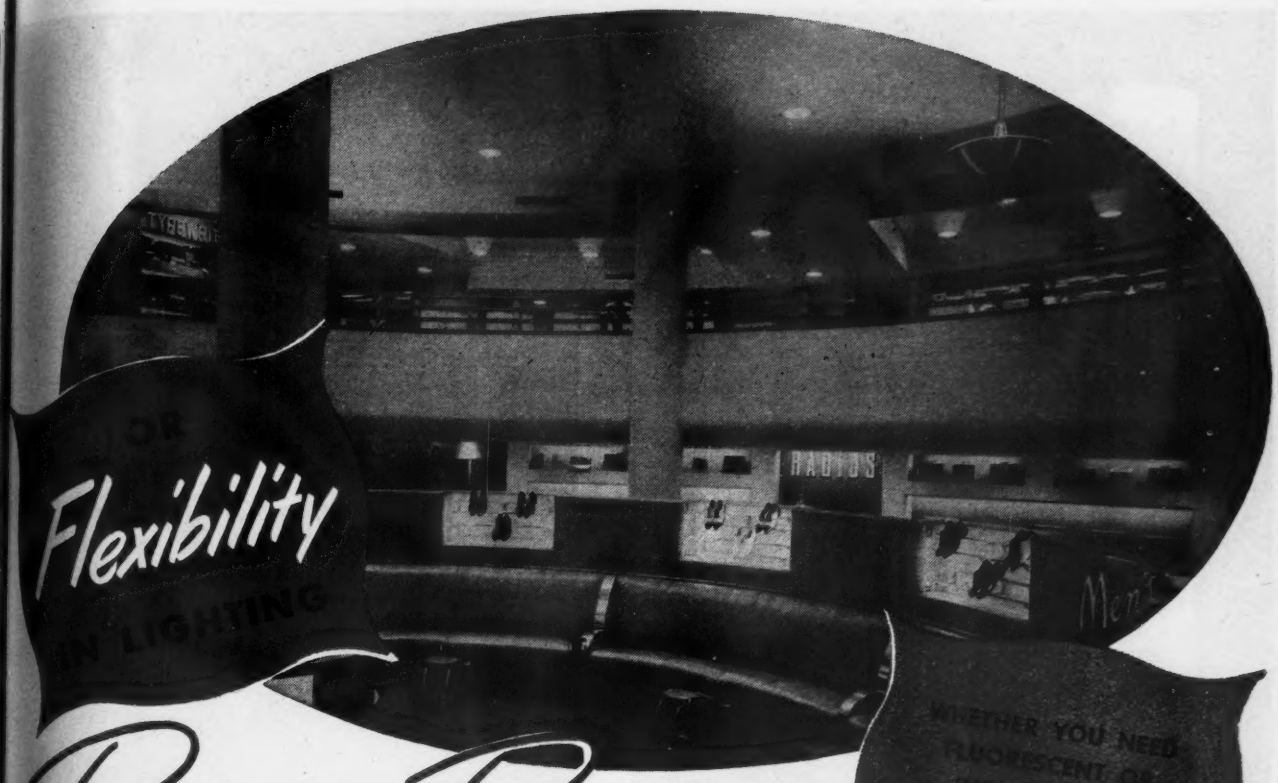
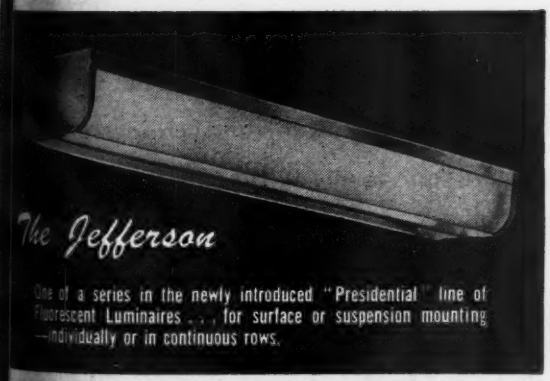
TRI-STATE SUPPLY CORPORATION

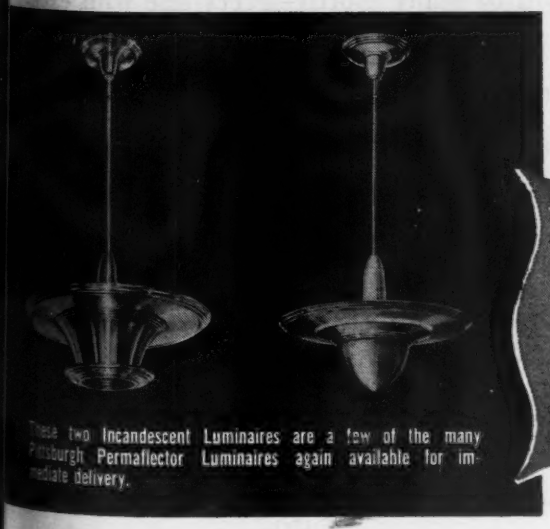
Manufactured by

THE P. D. GEORGE COMPANY, ST. LOUIS, U. S. A.



Pittsburgh Permaflector
LIGHTING EQUIPMENT


The Jefferson
One of a series in the newly introduced "Presidential" line of Fluorescent Luminaires . . . for surface or suspension mounting —individually or in continuous rows.


These two Incandescent Luminaires are a few of the many Pittsburgh Permaflector Luminaires again available for immediate delivery.

The above photograph of Spear & Co., Pittsburgh, illustrates the complete versatility of *Pittsburgh Permaflector* Lighting Equipment.

Here, both fluorescent and incandescent light sources are skillfully combined. In the main ceiling recessed louvered incandescent units, supplemented by indirect incandescent luminaires, give a pleasing, high intensity effect. Under and over the mezzanine balcony—recessed incandescent is augmented by fluorescent cove lighting. Fluorescent displays add points of interest.

This installation, and other outstanding installations throughout the United States and the world, typify the flexibility of *Pittsburgh Permaflector* Equipment.

When you want the distinctive in lighting—specify *Pittsburgh Permaflectors*. They are simple to install, easy to maintain and provide maximum lighting efficiency as well as flexibility of design.

Pittsburgh Reflector Company

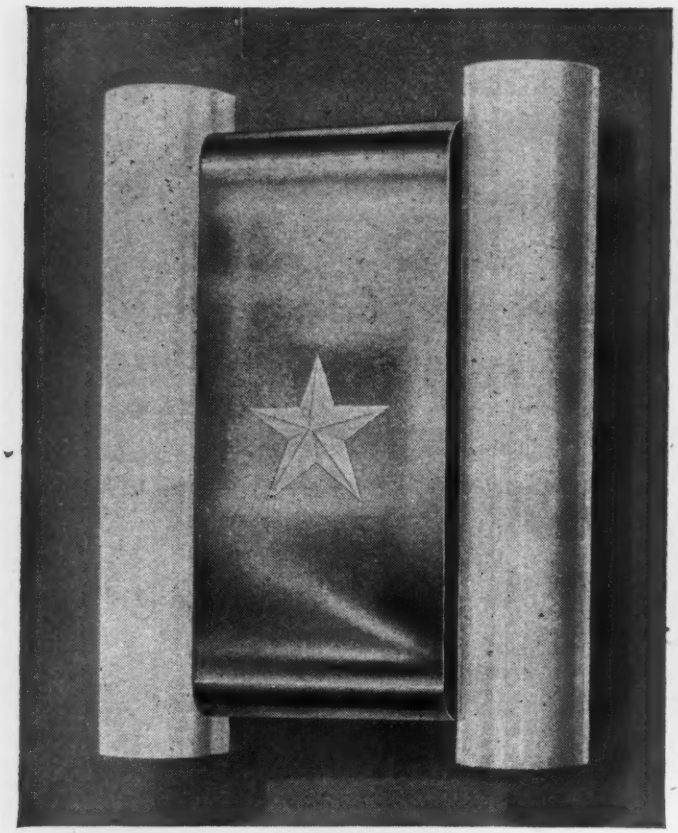
OLIVER BUILDING • PITTSBURGH 22, PA.

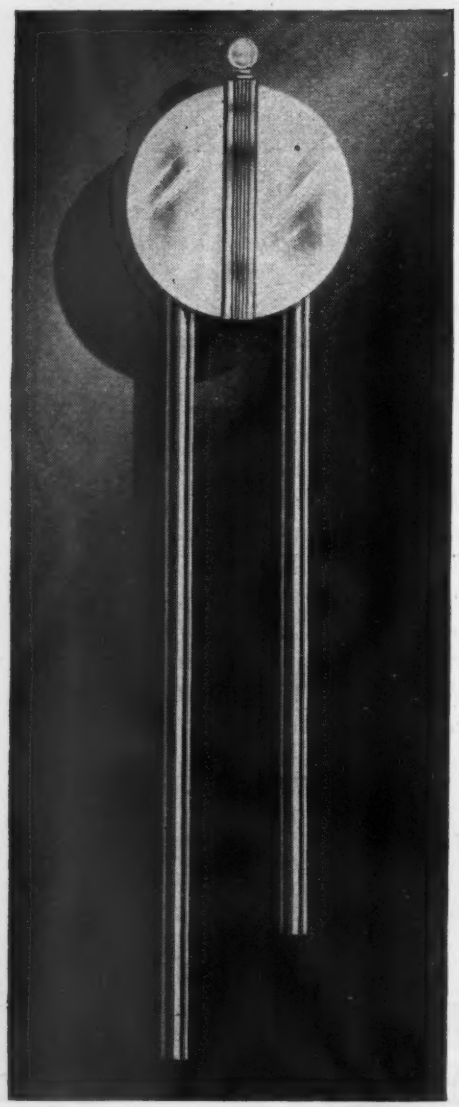
MANUFACTURERS OF PERMAFLECTOR LIGHTING EQUIPMENT
DISTRIBUTED BY BETTER ELECTRICAL WHOLESALERS EVERYWHERE

Permaflector Sales Engineers in All Principal Cities

PERMAFLECTORS • SPOTLIGHTS • FLOODLIGHTS • WIRING DEVICES • FLUORESCENT EQUIPMENT

"Pittsburgh" Permaflector





No other chimes like these!

• Here's a first glimpse of the newest in chimes—basically different in both tone and appearance. Laurelle Guild, one of the world's foremost designers, has created these chimes of lasting beauty. Their superlative tone is due to their individual resonators and Sonoscope tested tone bars—and tube developments that reflect the 73 years' experience of the oldest manufacturer of signaling devices.

Other models will be ready shortly—every one with exciting new sales appeal. All operate satisfactorily on any good quality transformer or battery, all are planned for ease of installation. A new catalogue bulletin illustrating and fully describing these and other models is now available. Send for your copy today.

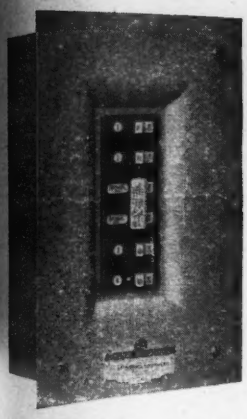
EDWARDS *Door Chimes*

EDWARDS AND COMPANY, NORWALK, CONN.

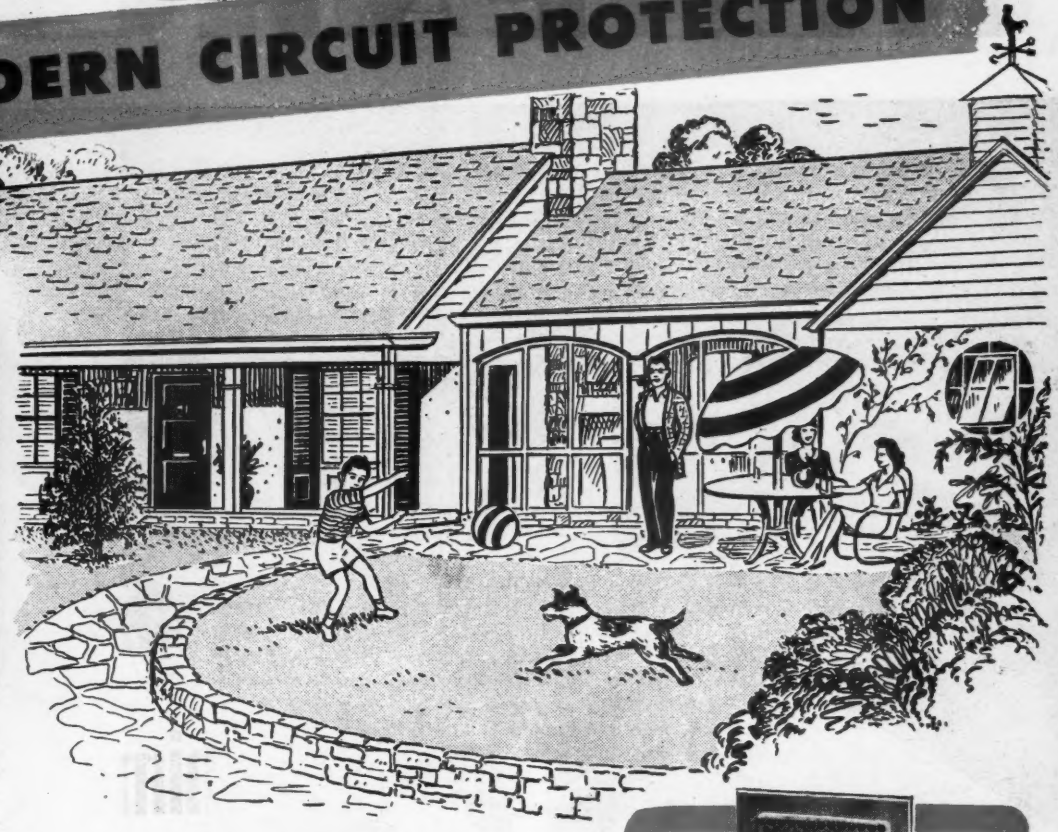
In Canada: Edwards & Co. of Canada, Ltd.

A modern home needs...

MODERN CIRCUIT PROTECTION



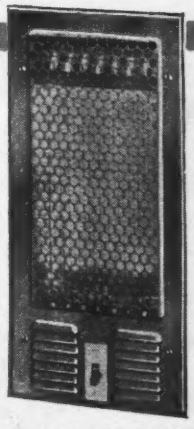
Ⓐ type AC circuit breaker Load Center with four single pole, and one double pole circuit breakers. List, $11.00. Maximum 16 poles.



HAPPY are the thousands of home owners who have Ⓐ type AC circuit breaker Load Centers or Service Equipment. To them, it means the finest in electrical protection and freedom from replacing blown fuses. A simple flip of the finger ...like on a light switch... restores service instantly, when the cause of trouble is removed. That's important to women, and many men, too.

But more important, is the Thermal-Magnetic protection Ⓐ Load Centers provide. Automatic Thermal trip on overload plus Magnetic disconnect on short circuit is a double protection for wiring and electric appliances.

Here's a tip for you, Mr. Architect, and you Mr. Contractor: when you specify Ⓐ Load Centers include a few spare circuits for those electrical conveniences Mr. and Mrs. America are dreaming about now. The cost is little, but the favor is a big one. We'll be glad to give you complete details.



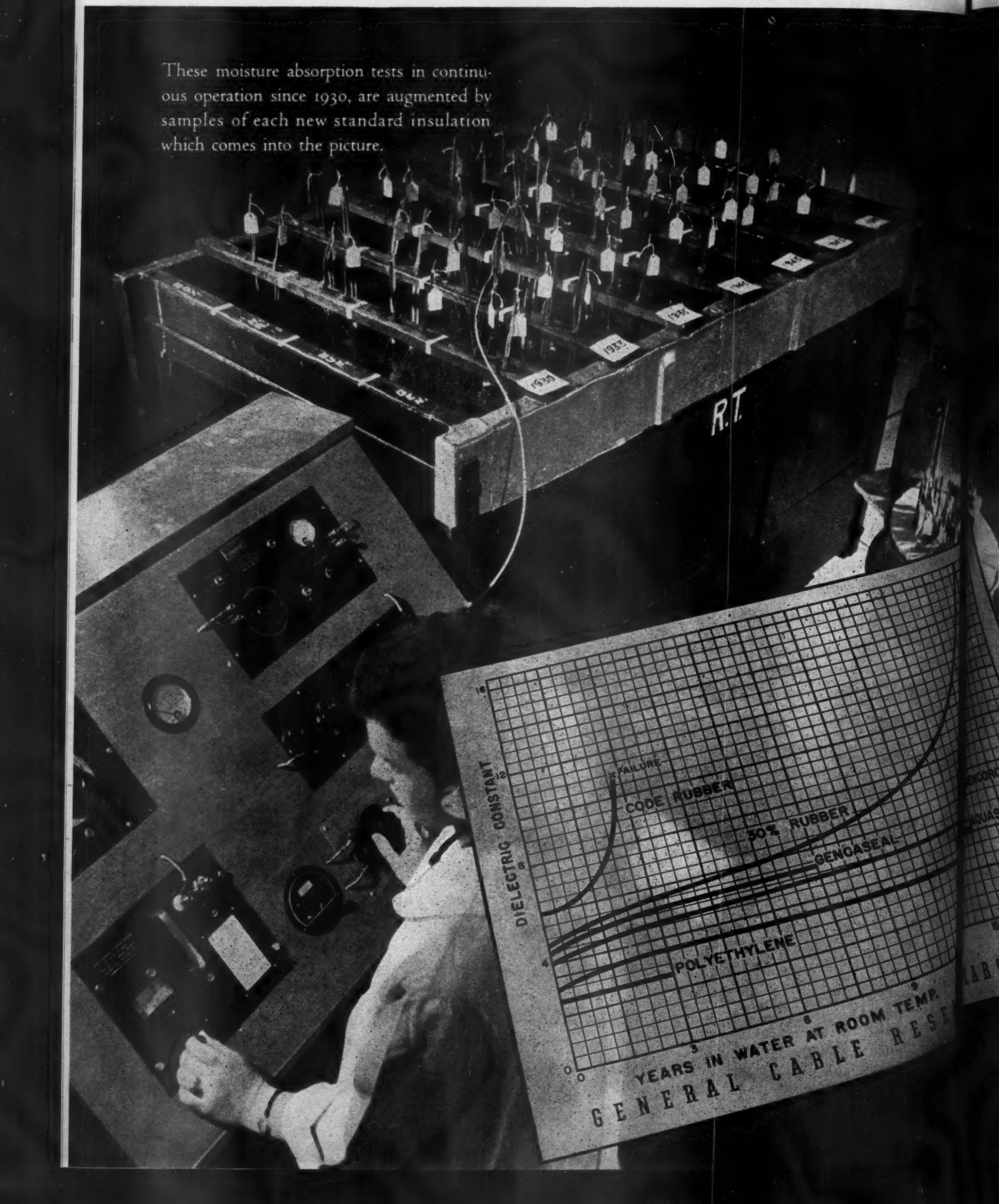
RETURNING SOON

The popular Ⓐ Quikheter. A built-in auxiliary, electric room heater that brings comfort and warmth to chilly rooms in just 3 minutes. No fan, or other moving parts to wear out, plus a Nichrome element that doesn't burn out. Priced as low as $30.00 list.

Frank Adam LOAD CENTERS

FRANK ADAM ELECTRIC CO., St. Louis — *Manufacturers of* Busduct, Panelboards, Switchboards and Enclosed Switches

RESEARCH . . .


These moisture absorption tests in continuous operation since 1930, are augmented by samples of each new standard insulation which comes into the picture.
R.T.
DIELECTRIC CONSTANT
FAILURE
CODE RUBBER
30% RUBBER
GENCASEAL
POLYETHYLENE
YEARS IN WATER AT ROOM TEMP.
GENERAL CABLE

...BY DECADES

Preparedness for Post-War Industry Developments based on cumulative data long in preparation

In the comparison of rubber insulating compounds and the new synthetics, it is easy and hazardous to jump at conclusions. Through the years, General Cable has been broadening its base of data by which to predict with some assurance the performance to be expected of the new materials. And out of practical experience, it recognizes, too, that there is no substitute for time in the determination of the industry's final answers.

These and other tests, extending over years of simulated service conditions, prepare General Cable to furnish synthetic insulations for all operating conditions.

GENERAL CABLE CORPORATION

General Cable Corporation Sales Offices are located at Atlanta, Boston, Buffalo, Chicago, Cincinnati, Cleveland, Dallas, Detroit, Houston, Kansas City (Mo.), Los Angeles, New York, Philadelphia, Pittsburgh, Rome (N.Y.), St. Louis, San Francisco, Seattle, Washington (D. C.)

Now—a silicone varnish that cures at 300°F

DC 996 VARNISH

DOW CORNING
SILICONES

Dow Corning 996 is an electrical impregnating varnish for low temperature baking.

Dow Corning 996 was developed to provide manufacturers of new equipment and rewinders of old equipment with a heat resistant, waterproof silicone varnish which can be cured at temperatures obtainable in ovens now used for curing organic insulating varnishes.

Dow Corning 996 is used as the dipping or impregnating varnish for equipment wound with typical silicone insulation components. These include Fiberglas cloth, tape and sleeving varnished with DC 993; silicone bonded mica-Fiberglas for ground insulation; silicone bonded Fiberglas served magnet wire; silicone-Fiberglas laminated coil separators and slot sticks, and Silastic* coated lead wire.

Electrical equipment, wound with silicone insulating components and sealed by impregnating with DC 996, will have the high order of thermal stability and retention of waterproofness characteristic of silicone insulation.

Dow Corning 996 thus enables all types of electrical shops to realize the advantages of silicone insulation. It is recommended for use in equipment which is to be operated at temperatures up to 175°C. (347°F.). For higher operating temperatures, or extremely severe service conditions, DC 993 should be used throughout. The same methods of dipping, spraying, or vacuum-pressure impregnating that are used for applying conventional organic varnishes can be used with DC 996.

PROPERTIES—Dow Corning 996 is furnished as a 50 per cent by weight solution in an aromatic solvent and has a viscosity of 2 to 5 poises. In this consistency DC 996 is suitable for impregnating electrical equipment. It can be reduced to any desired viscosity with aromatic naphtha.

Dow Corning 996, when coated on metal, air dries to a slightly tacky, soft film. Baking the coated panel at 150°C. (302°F.) for a period of four hours will cure the coating to a non-flowing, tack-free, flexible film. DC 996 has ample heat stability for continuous use at temperatures as high as 175°C. or for intermittent use at higher temperatures.

ELECTRICAL PROPERTIES OF DC 996—(measured on coated panels at 25°C. and 50% relative humidity.)

Dielectric Strength, volts per mil	1500 to 2000
Dielectric Constant, at 1000 cycles	3.0
Power Factor, at 1000 cycles	0.7%

DOW CORNING CORPORATION
MIDLAND, MICHIGAN
NEW YORK OFFICE: EMPIRE STATE BUILDING

DISTRIBUTED BY

Electrical Specialty Co. ..... San Francisco
Prehler Electrical Insulation Company ..... Chicago
Insulation Manufacturers Corporation ..... Chicago
Insulation and Wires, Incorporated ..... St. Louis
Mica Insulator Company ..... Schenectady
National Electric Coil Company ..... Columbus
Westinghouse Electric Corporation
Insulation Section, Micarta Division .... Trafford, Penna.

* Trade name for Dow Corning Silicone Rubber

Dow Corning
FIRST IN SILICONES

MODERN WIRING . . . . .

Requires

AMPLE CARRYING CAPACITY FOR THE ELECTRICAL LOAD

. . . This means more branch circuits . . . larger copper wires . . . and plenty of properly located convenience outlets

MODERN PORCELAIN PROTECTED WIRING SYSTEMS ADEQUATELY *for* SUPPLY ALL THIS . . . .

Porcelain is the oldest system of wiring and has kept pace with the need for modernization. The very fact that it is preferred in so many localities is evidence of its durability for construction and building design. Industries, Warehouses, Stores, Homes, Garages, and other buildings of frame or fired brick, tile, or cement construction come under the type suitable for wiring with Porcelain Protected Wiring.

The Code, by virtue of long experience, has provided, thru the years, rules necessary for the protection of the conductors and these are found in Articles 320 and 324. They are simple, yet meet every contingency. These rules were built around porcelain as the ideal insulator. They provide for supports and spacing of the conductors.

The use of flexible tubing and means for separating wires from metal work as well as protection from mechanical injury are clearly indicated. Now, with porcelain outlet boxes, the system is completely and adequately insulated, thus providing Safety all through the system with PERMANENCE.

Entrances to wiring systems can be fully protected from shorts and grounds with porcelain outlet boxes. They are non-conductive and preclude shorts due to poorly taped wires or fires and accidents due to condensation effects as frequently occurs in kitchens, bathrooms, and basements.

Modern Porcelain Protected Wiring Systems are based on FUNDAMENTAL PRINCIPLES which have long been established practice. New ideas have prevailed for a time but, because none have embodied the basic principles to the same extent as the Porcelain Protected Wiring System, it continues to be the most practical and desirable.

Safe wiring, like basic facts, cannot be cast aside. The basic elements which make a wiring method substantial in practice as well as in principle are the same as those which determine the values of all other time-proven methods of operation.

★ **ILLINOIS ELECTRIC PORCELAIN CO.** — *Macomb, Ill.*

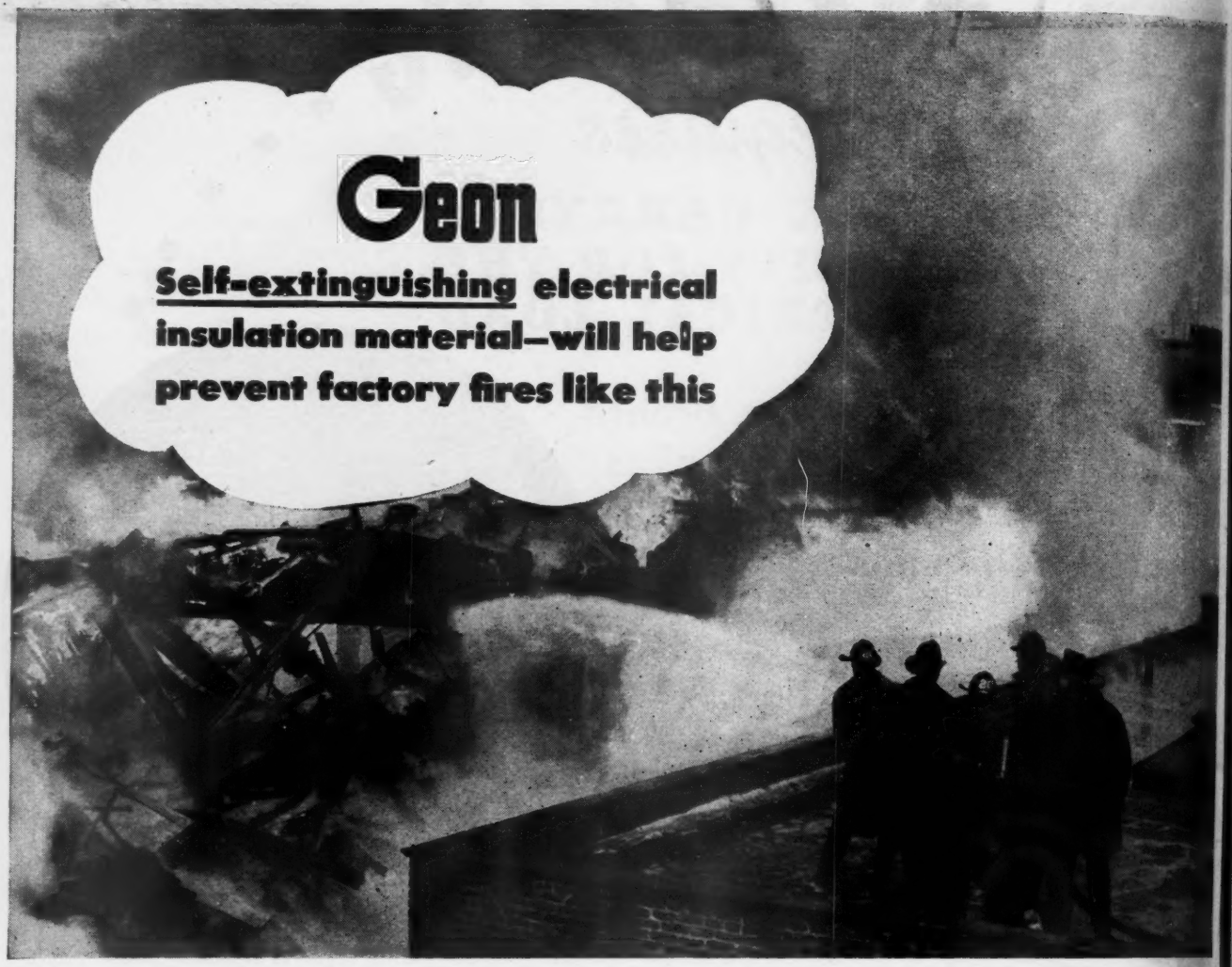
★ **PORCELAIN PRODUCTS, INCORPORATED** — *Findlay, Ohio*

★ **IPECIALTY PORCELAIN WORKS** — *East Liverpool, Ohio*

★ **SUPERIOR PORCELAIN COMPANY** — *Parkersburg, W. Va.*

★ **UNIVERSAL CLAY PRODUCTS COMPANY** — *Sandusky, Ohio*

MODERN PORCELAIN PROTECTED WIRING SYSTEMS



AN overloaded or short-circuited electrical line—wires get hot—insulation bursts into flame—acts like a fuse, carrying fire to all parts of the plant. Another disaster that might have been prevented.

Fires like that *can* be prevented through the use of flame-resisting, self-extinguishing GEON, the raw material for electrical insulation that combines outstanding electrical properties with positive resistance to burning. But those are just two of the properties of this polyvinyl material that offers many *new* advantages in industrial, domestic and utility wiring.

For example, insulation of GEON lasts almost indefinitely because it resists ozone, air and sunlight. Its electrical properties permit a thinner layer of insulation—make possible more conductors, more capacity per conduit. The outer surface of GEON insulation is smooth and slick to permit faster installation. It can be made in a wide variety of colors for quick identification. Its resistance to heat and cold means perfect performance under severe conditions. Its imperviousness to acids and water permits safe and economical underground use. These many desirable properties can be had in a wide variety of combinations to meet specific service conditions.

Our development staff and laboratory facilities are available to help you work out any special problems or applications. For more complete information write Department YY-10, B. F. Goodrich Chemical Company, Rose Building, Cleveland 15, Ohio.

Geon
Polyvinyl Materials

B. F. Goodrich Chemical Company

A DIVISION OF THE B. F. GOODRICH COMPANY

SERVICE TEST REPORT

A Westinghouse Air-Cooled Transformer was subjected to special and abnormally severe moisture and temperature tests for 2000 hours. After 16 hours of heavy loading, the transformer was de-energized and a spray of water was directed on the windings for five minutes. The transformer remained de-energized for eight hours. This test was repeated each day. The standard dielectric test was applied weekly. No failure of any kind resulted.

Today's requirements for safe and reliable indoor transformers all point to dry, air-cooled equipment.

The proof is in the growing preference for Westinghouse Air-Cooled Transformers and Power Centers, for service in all types of plants, from subarctic climates to the tropics.

Here are the reasons. Because air cooling does away with the fire and explosive hazards of liquids, it is SAFER. Freedom from liquid seepages and sludge makes it CLEANER. As air-cooled transformers need no vaults or catch basins, they are EASIER TO INSTALL. Because there's no time out required for liquid reconditioning or refilling, they are EASIER TO MAINTAIN.

Get the latest facts on AIR-COOLED design. Write for booklet B-3459, "Air Cooling". Westinghouse Electric Corporation, P.O. Box 868, Pittsburgh 30, Pennsylvania.

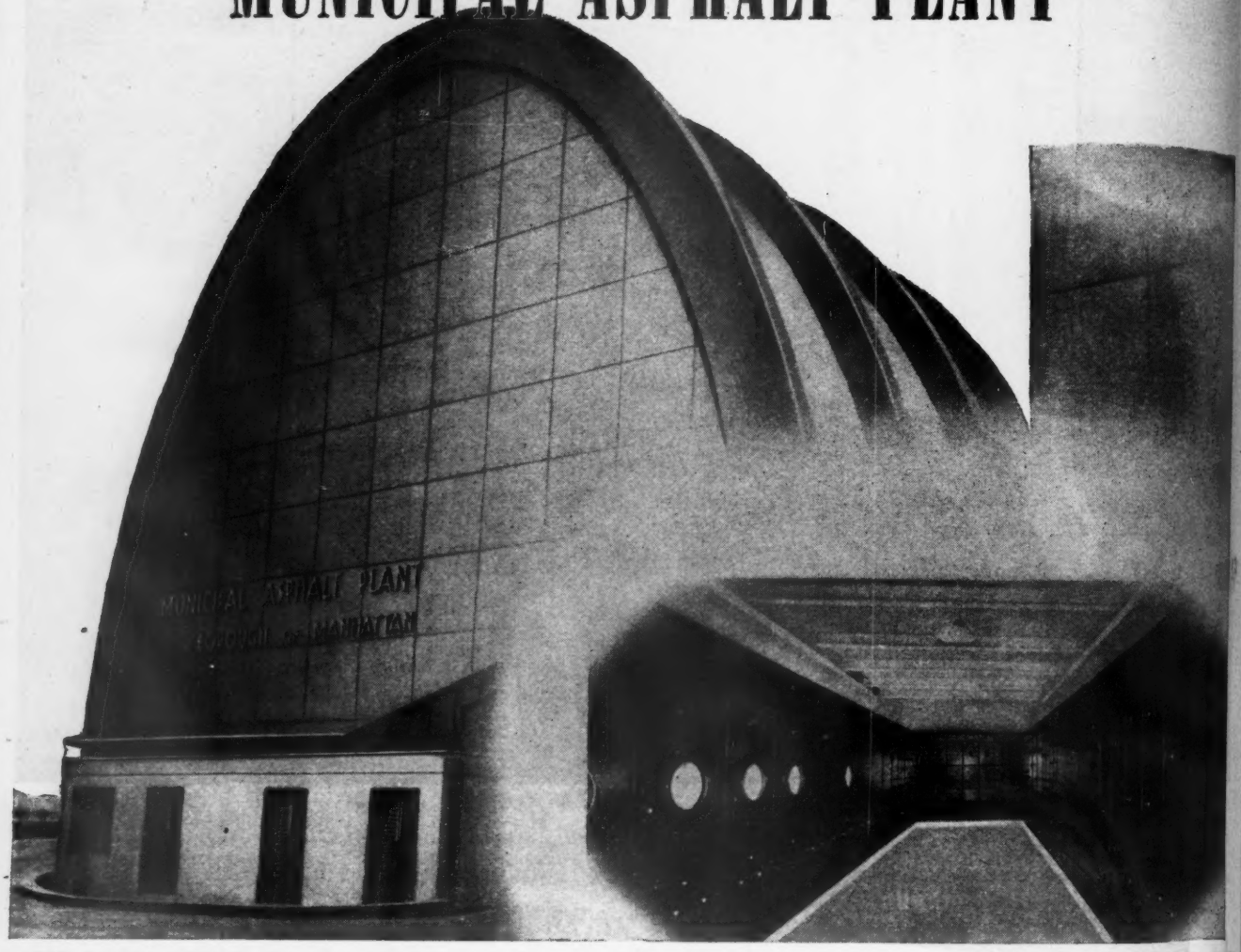
J-70452

Westinghouse *Air Cooled* TRANSFORMERS

METROPOLITAN'S ELECTRICAL UNIT

FOR HEATING, MOTOR AND LIGHT CONTROL IN THE

MUNICIPAL ASPHALT PLANT



At the right are listed various types of electrical control equipment designed and furnished by METROPOLITAN for utilities, industrial plants, large mercantile establishments, and public buildings. Your inquiries are invited.

Knife Switchboards	Motor Control Switchboards
Circuit Breaker Switchboards	Explosion-proof Switchboards
Dead Front Switchboards	Laboratory and Test Switchboards
Battery Charging Switchboards	Control Switchboards

Generator and Distribution Switchboards

Complete Electrical Control by

ESTABLISHED 1892 METROPOLITAN TRADE MARK

ELECTRIC MANUFACTURING COMPANY

ELECTRIC LIGHTING AND POWER DISTRIBUTION EQUIPMENT

LONG ISLAND CITY NEW YORK

PROFITS { BIG QUICK STEADY

General Electric Offers You a Complete Program for the Commercial Lighting Market

WHATEVER type of lighting business you do—whether it's store lighting, office, home or industrial—you can make more money out of it if you tie-in with the G-E Lamp Department's big, and complete lighting programs. G-E offers you a sound and sales-producing program for each field. Since the largest immediate demand comes from stores, the commercial lighting program is the first to be presented—it's ready now!

Most of the stores in your community are prospects for big, quick and steady lighting profits:

BIG—because surveys show that eight out of ten stores want new lighting . . . and because new lamps developed by G-E Lamp Research make possible better lighting installations than ever before.

QUICK—because stores are well aware that normal, competitive retailing is returning fast . . . and because they know that the quicker they improve their lighting the better their competitive position will be.

STEADY—because when you install a new lighting job you have an opportunity to sign up the store for a profitable lamp replacement and lighting service business that will continue to bring you profits for years to come.

Turn to the following pages for information about SEEING IS THE BIGGEST THING IN SELLING, the big new program prepared by General Electric to help you develop your commercial lighting business.

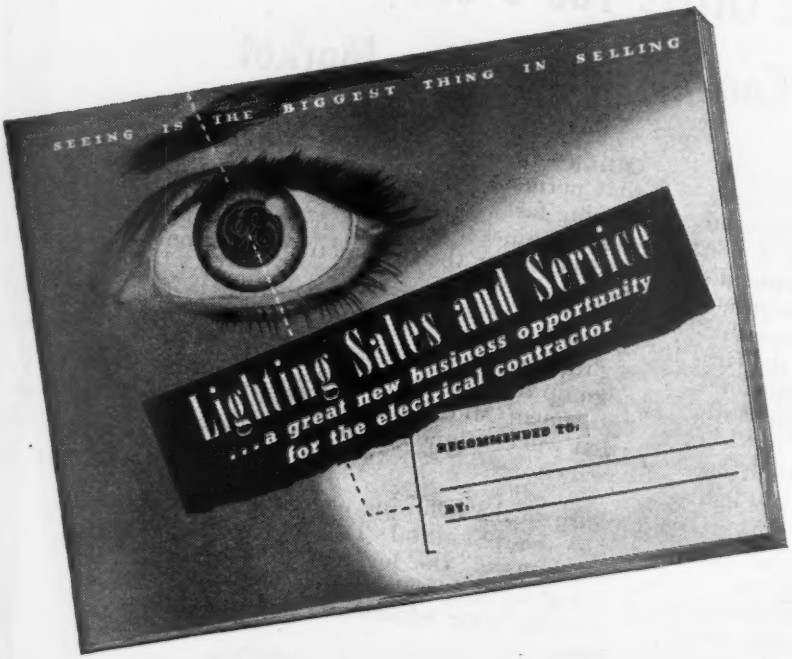
G-E LAMPS

GENERAL ELECTRIC

SEEING is the biggest thing in SELLING

GENERAL ELECTRIC'S complete program for the commercial lighting market—SEEING IS THE BIGGEST THING IN SELLING—is ready for you now. Your General Electric Lamp Representative has the complete details—see him without delay. The sooner you see him the greater your competitive advantage will be. Here is a brief outline of the program:

1 How to get the most out of your Commercial Lighting Business



To take full advantage of the profitable opportunities in lighting you'll want to know just where the business is and how to go about getting it in a profitable way. G-E's new booklet, LIGHTING SALES AND SERVICE, gives you the answers. It's the foundation for your whole commercial lighting activity—be sure to get a copy from your G-E Lamp Representative.

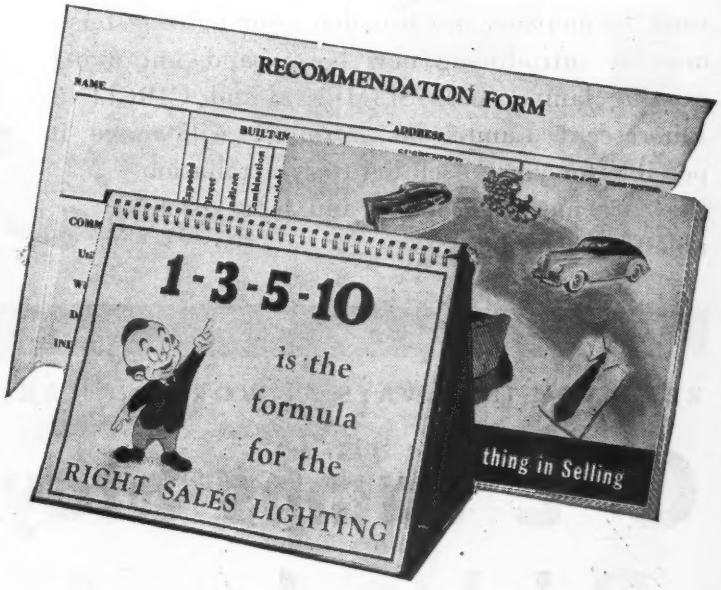
G-E LAMPS

2 How to train For Better Lighting Salesmanship

Even experienced lighting men will benefit from a refresher course on commercial lighting. G-E Lamp training courses have established an outstanding reputation over the years. This new course, worked out in cooperation with the famous LaSalle Extension University, is the best ever offered. It costs only $12.50—for five texts, a personal consultation service and a diploma. Ask your G-E Lamp Representative to show it to you!

3 How to make More Lighting Sales

Stores want new lighting . . . but the amount of profit you make depends on the kind of job you sell them. G-E has prepared a compact, colorful Visualizer that sets up right on a desk or counter to help you show the store-owner exactly what modern lighting can do for him. To help you clinch the sale, G-E offers you an attractive new booklet to leave with him, and a handy recommendation form that will help you make speedy lighting recommendations. Ask your G-E Lamp Representative to show you these powerful sales aids!



IT'S A BIG MARKET...
MADE ALL THE BIGGER BY

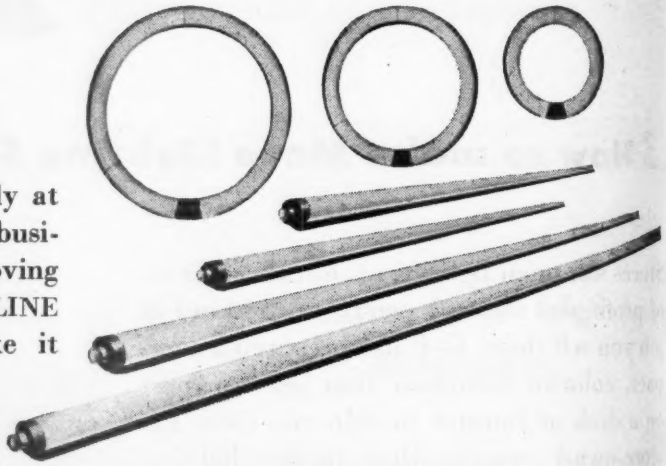
GENERAL ELECTRIC

ADVERTISING
to help presell your prospects

More than 40 trade publications carry G-E Lamp advertising to prospective purchasers of commercial lighting—everything from banks to beauty shops and garages to groceries. All these ads support your sales efforts and drive home the fact that SEEING IS THE BIGGEST THING IN SELLING.

NEW LAMPS
from G-E Lamp Research

General Electric Lamp Research is constantly at work to increase and broaden your lighting business by introducing new lamps and improving existing lamps. G-E SLIMLINE and CIRCLINE Fluorescent Lamps for example, will make it possible for you to sell lighting installations that are more attractive and more profitable than ever before.



RESEARCH IS ALWAYS AT WORK TO MAKE

G-E Lamps Stay Brighter Longer

GENERAL ELECTRIC

CROUSE-HINDS

Industrial Lighting Fixtures

The illustrations show a representative selection from the hundreds of different CROUSE-HINDS lighting fixtures—each designed for its own particular purpose.

No. 3
of a series of advertisements which demonstrate that CROUSE-HINDS "complete line" means much more than just a range of sizes—there is a wide variety of highly specialized types in each classification.

Type C Condulet with No. 1705 Lamp Receptacle

Type GRF Watertight Pilot Light Condulet

Type FS Lighting Fixture for flush mounting in walls to light steps, floors, walks and gardens

Type FS Condulet with Pilot Light, Switch, and Lamp Receptacle

Type G Condulet with No. 1556 Lamp Receptacle

Type VR Vaportight Lighting Condulet *for mounting on a hand rail*

Type EVS Explosion-Proof Portable Lamp

Type EVH Explosion-Proof Hand Lamp

Type EVA Explosion-Proof Pilot Light Condulet

Type LG Gauge Lamp

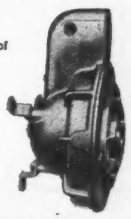
Type EGP Explosion-Proof Pilot Light Condulet *for panel mounting*

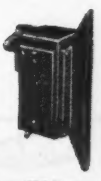
Type VXJ Vaportight Lighting Condulet *for making extensions from concealed conduit wiring*

Type RMC Watertight Marine Lighting Fixture

Type LPH Safety Hand Lamp

Type VS91 Vaportight Hand Lamp


Type RCDE-8 Explosion-Proof Pit Light


Type VFC Vaportight Gauge Lighting Condulet

Type GSC Condulet with Bracket Lighting Fixture

Type MB Two-Gang Watertight Marine Pilot Light Condulet

Type V Vaportight Heavy Duty Lighting Condulet with Shatterproof Globe *for use in the food industry*

Type MLC Watertight Marine Lighting Condulet Shock-Absorbing Receptacle

Type EVG Explosion-Proof Lighting Condulet *for gasoline pumps*

Type RCD-8 Vaportight Lighting Fixture *for wall mounting*

Type RCD-8 Vaportight Lighting Fixture *for floor mounting*

Type VFC Vaportight Gauge Lighting Condulet

Type V Vaportight Lighting Condulet for mounting on machines

Type EFS Explosion-Proof Condulet with Double Pilot Light

Type GS Condulet with Shock-Absorbing Lamp Receptacle for use on machinery

Type VDA Vaportight Observation Light Condulet *for mounting in vats*

Type C Condulet with Type ARC Vaportight Lighting Fixture

Type MLC Watertight Marine Lighting Condulet

Type LMKB Lighting Condulet

Type WV Vaportight Lighting Condulet with Fresnel Lens

Type VXHA Vaportight Lighting Condulet with Flush Hubs

Type VC Vaportight Lighting Fixture Condulet

Type DLA Dust-Tight Lighting Fixture Condulet with Flat Cone Reflector

Type EVA Explosion-Proof Lighting Fixture Condulet

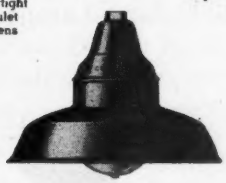
Type VLG Vaportight Gauge Lighting Condulet *Fluorescent*

Type ELG Explosion-Proof Gauge Lighting Condulet

Type LMG Lighting Condulet

Type ELG Explosion-Proof Gauge Lighting Condulet *Fluorescent*

Type VPH Vaportight Indirect Lighting Condulet


Type VDB Vaportight Lighting Fixture Condulet with Dome Reflector *500-Watt*

Type DLA Dust-Tight Lighting Fixture Condulet *500-Watt*

Type EVA Explosion-Proof Lighting Fixture Condulet *500-Watt*

Type HNDS Condulet with Lighted Sign

Type EVA Explosion-Proof Sign Light Condulet

A Nationwide Distribution Through Electrical Wholesalers

Complete listings of each type are in Condulet Catalog No. 2500 or in supplementary bulletins.

CROUSE-HINDS COMPANY
Syracuse 1, N. Y., U.S.A.

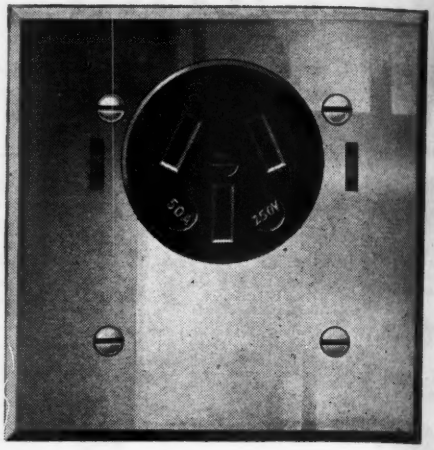
Offices: Birmingham — Boston — Buffalo — Chicago — Cincinnati — Cleveland — Dallas — Denver — Detroit — Houston — Kansas City — Los Angeles — Milwaukee — Minneapolis New York — Philadelphia — Pittsburgh — San Francisco — Seattle — St. Louis — Washington. *Resident Product Engineers:* Albany — Atlanta — Charlotte
CROUSE-HINDS COMPANY OF CANADA, LTD., *Main Office and Plant:* TORONTO, ONT.

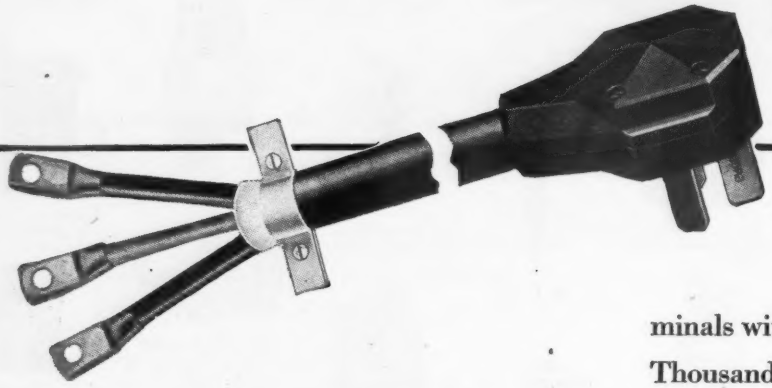
CONDULETS · TRAFFIC SIGNALS · AIRPORT LIGHTING · FLOODLIGHTS

better home wiring calls for

BRYANT

RANGE CONNECTORS





Electric ranges stand near the top of the buying list of tens of thousands of home owners who plan to modernize or build. For the quickest, safest and most convenient way of connecting electric ranges to the line, use Bryant Range Connectors and Cord Sets.

The Bryant No. 3846 Range Connector is a 3-wire polarized outlet for flush mounting with a Bakelite receptacle and solderless terminals with a rating of 50 amperes, 250 volts. Thousands of these connectors have been proved in use in homes everywhere. No new home should be built without one.

Companions to this receptacle are the Bryant 3-wire polarized Range Cord Sets with welded contacts and a heavy, non-separable Bakelite head. Standard 36 inches in length, they assure ample connecting convenience. Catalog No. 3898 is for 35 ampere and No. 3899 for 50 ampere circuits.

Specify Bryant Devices from your Electrical Wholesaler

THE BRYANT ELECTRIC COMPANY

BRIDGEPORT 2, CONNECTICUT

SUPERIOR WIRING DEVICES

ARMY E NAVY

NEW YORK SAN FRANCISCO CHICAGO LOS ANGELES

A SUBSIDIARY OF WESTINGHOUSE ELECTRIC CORPORATION

SURFACE MOUNTING CONNECTOR

Designed for surface mounting in home modernization, the Bryant No. 3826 Range Connector is equipped with solderless terminals and a rugged Bakelite housing. Rating—50 amperes, 250 volts. ¾ inch and 1 inch knockouts in back and bottom provide for conduit connections.

The Advance Model RESEARCH LUMINAIRE

FLUORESCENT LIGHTING FIXTURE

Engineered out of the experience and findings of leaders in better lighting.

Made for 2, 4, or 6 lamps with BUILT-IN REFLECTOR.

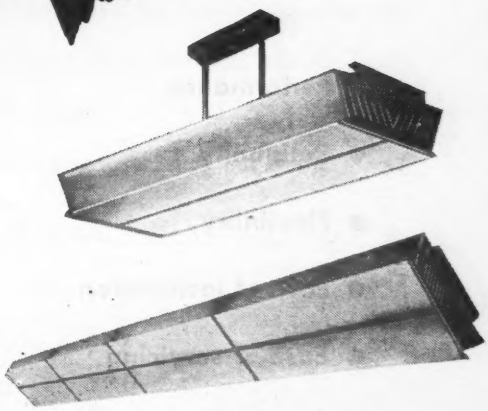
...9-Point Superiority

Several years ago, Solarite engineers collaborated with Utilities Research Commission in developing an efficient and practical luminaire of low surface brightness in the interest of "Better Light—Better Sight" standards. The result of this effort was the Research Luminaire.

We put this question to lighting engineers, architects, contractors and building superintendents: "What are your experiences in fluorescent lighting? What do you require with respect to lighting performance, installation and maintenance?".

The ADVANCE MODEL is your 9-point answer.

It features: 1. Improved Rigid Construction. 2. Longer Ballast Life. 3. Easily Replaced Standard Sockets. 4. New Improved Steel Reflector. 5. "Plasteel" Center Bar. 6. Accessible Glass Panels. 7. Cool Daylight Comfort. 8. Streamlined Beauty. 9. Tested—Certified—Guaranteed.



5 Mounting Application
Individual or Continuous Line

SOLAR LIGHT MANUFACTURING CO.

718 W. WASHINGTON BLVD., CHICAGO 6, ILL.

"These Six Factors Make

WEBSTER ELECTRIC Teletalk

REG. U.S. PAT. OFFICE

Sales Easy"...

Says Mr. Wilkins, after 10 years of successful selling

Mr. M. L. Wilkins, Manager of the Oakland, California, office of the Graybar Electric Company, says, "Teletalk is a fast-selling line. In my ten years of selling Teletalk equipment, these six factors have been important in influencing sales:

- **Performance**
- **Reliability**
- **Flexibility**
- **Ease of installation**
- **Ease of servicing**
- **Availability of replacement facilities**

"Customers buy Teletalk because of good performance, good appearance, ease of installation and—most important—because it's easy to use."

Mr. Wilkins uses direct mail, makes personal calls on prospects and follows up customer leads by individual selling effort. He feels that it is important for a salesman to be on the active lookout for possible Teletalk installations. He finds that regular Teletalk models fit most customer demands.

Pushing the sale of Teletalk as a regular part of your business is profitable, for yourself and your organization, as Mr. Wilkins' experience shows.

Licensed under U. S. Patents of Western Electric Company, Incorporated, and American Telephone and Telegraph Company

KEEP ON BUYING BONDS

WEBSTER ELECTRIC

Racine, Wisconsin, U.S.A. • Established 1909 • Export Dept.: 13 E. 40th Street, New York (16), N. Y. Cable Address "ARLAB" New York City

"Where Quality is a Responsibility and Fair Dealing an Obligation"

INTRODUCED a few months ago, Super-stik—the improved friction tape—has set an amazing record in distribution. Leading independent electrical wholesalers everywhere enjoy our exclusive franchise. The map tells the story! If you haven't tried Super-stik—ask for a sample.

Independent Wholesalers—If your territory is not covered on our map, write us.

SUPERIOR INSULATING TAPE CO. • ST. LOUIS, MO., U.S.A.

Established 1923

Ready Now!

Each 75-ft. roll individually wrapped and sealed in cellophane. Packed 10 rolls to the can.

S-750

Super-stik

FRICTION TAPE

"Sticks to the End"

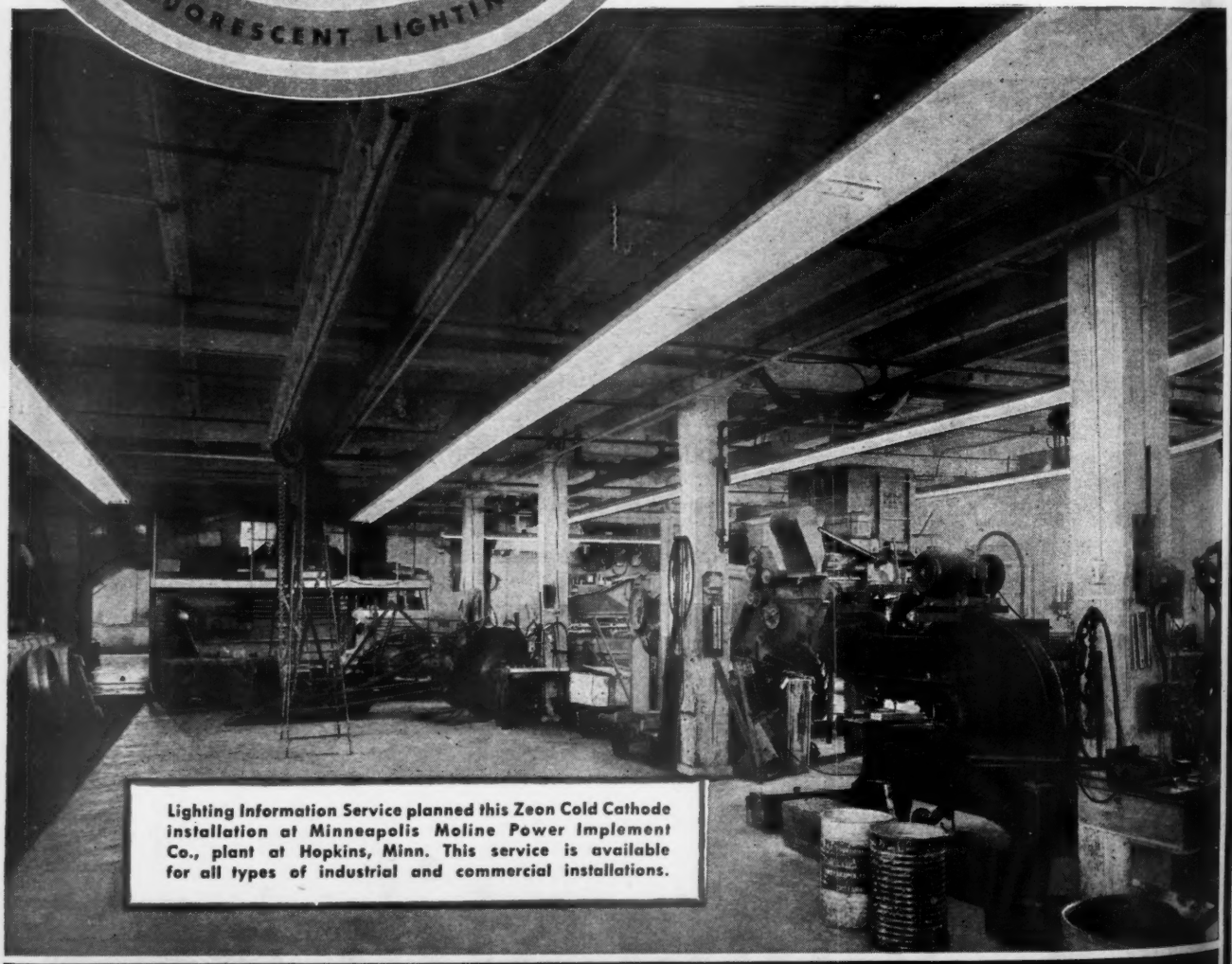
Obtainable only from factory authorized electrical wholesalers

2 things to do...to get More Effective

1 Use Zeon Cold Cathode Fluorescent Lamps

FEDERAL ELECTRIC
ZEON
COLD CATHODE
FLUORESCENT LIGHTING

There are two kinds of fluorescent lighting. "Hot Cathode" is the common heater filament type of fluorescent lamp; "Cold Cathode" is the improved, shell electrode type, of which Zeon is the outstanding example. Long life, lower maintenance cost, and greater flexibility are some advantages of Zeon Cold Cathode lighting. Lamps start instantly, without flicker; electrodes last indefinitely—far beyond the 10,000-hour life rating of Zeon lamps. Minimum replacement saves time. saves money.



Lighting Information Service planned this Zeon Cold Cathode installation at Minneapolis Moline Power Implement Co., plant at Hopkins, Minn. This service is available for all types of industrial and commercial installations.

FEDERAL ELECTRIC COMPANY, INC.

8700 S. STATE STREET, CHICAGO 19, ILL.
TELEPHONE VINCENNES 5300

225 N. MICHIGAN AVE., CHICAGO 1, ILL.
TELEPHONE STATE 0488

SUBSIDIARY COMPANY . . . FEDERAL BRILLIANT COMPANY, ST. LOUIS, MO.

Branch Offices: Cincinnati • Dallas • Duluth • Houston • Indianapolis • Kansas City • Louisville • Milwaukee • Minneapolis • New Orleans • New York • Philadelphia

FLUORESCENT LIGHTING

2 Get Lighting Information Service . . . .

Through Lighting Information Service, Federal Electric Company, Inc., now offers expert assistance in planning fluorescent lighting installations. This service makes available to you engineering counsel that is based on 15 years experience in manufacturing gaseous discharge lamps, and in planning fluorescent lighting installations.

Laying out an extensive lighting installation is a complicated job. To get the most effective results involves the consideration of factors often incompletely understood, at times not even recognized. This is equally true of fluorescent lighting. It is important to Federal Electric Company, Inc., and to the whole lighting industry, that the many new installations of fluorescent lighting are planned so that the user enjoys the full benefit of the glareless illumination, flexibility, and economy of fluorescent lighting.

Therefore Federal Electric urges you, your architect, consulting engineer, and electrical contractor to take advantage of Lighting Information Service, without charge or obligation.

Lighting Information Service—How it Works

Lighting Information Service is simply specialized advice to your architect, consulting engineer, or electrical contractor, and to you. It does not replace their services.

Our lighting engineers will study your problem and recommend type, color, size, number of lamps; type, spacing, height of fixtures; loads, wiring, transformers required.

Lighting Information Service—How to Get It

Simply fill in the form at the right, pin to your business letterhead, and mail to Federal Electric Company, Inc., at any of the addresses given below.

Or, if you prefer, give this information in a letter, fully describing the details of your problem. If possible, send a photograph of the space to be lighted. This will be valuable.

There is no obligation, other than your cooperation in giving us the fullest possible information, so that we can give you the best possible recommendation.

USE THIS FORM

FREE LIGHTING INFORMATION SERVICE REQUEST FORM

Lighting Engineering Staff
FEDERAL ELECTRIC COMPANY, Inc., 8700 S. State St., Chicago 19, Ill.

Gentlemen: The following information is given you to help solve my lighting problem. I understand there will be no charge or obligation for this service.
(Please check or fill in proper spaces below) (Send photograph if possible)

Space To Be Lighted
Shop . . . . . ☐ Lobby . ☐
Store . . . . . ☐ Halls . . ☐
Auditorium . . ☐ Factory ☐
Office . . . . . ☐

Size
Height ____ ft.
Length ____ ft.
Width ____ ft.

Colors, Walls, etc.
Ceilings: Light . . . ☐ Medium . . ☐ Dark . ☐
Walls: Light . . . ☐ Medium . . ☐ Dark . . ☐
Floor: Linoleum ☐ Carpeting ☐ Wood ☐
Concrete ☐ Stone, etc. ☐ Others ☐

Type _____ Construction _____

Work For Which Lighting Is Required
General . . . . . ☐ On dark material . . ☐
Reading . . . . . ☐ Display . . . . . ☐
Drafting . . . . . ☐ Decorative . . . . . ☐
Shop Work . . . . . ☐ Proofreading . . . . . ☐

Present Lighting
Type _____
Footcandles (if known)
Now _____ fc. Needed _____ fc.
Current available
Type _____ Phase _____ Cycles _____ Volts _____

Windows: Area, Approx., total _____ sq. ft. Exposure: ☐ North ☐ South ☐ West ☐ East

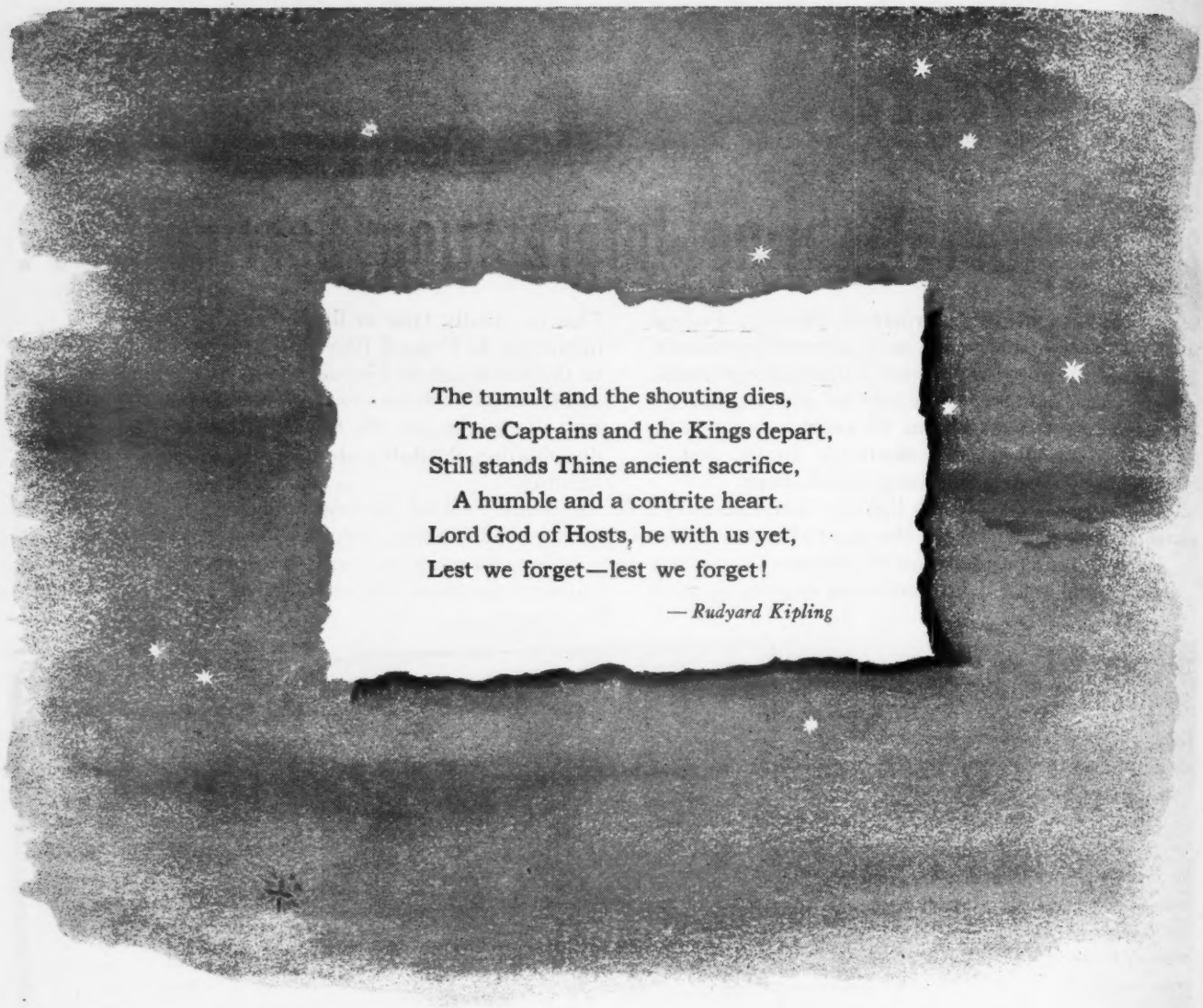
CHANGES CONTEMPLATED: (any changes in structure, equipment, colors, windows, or use of space, that would affect lighting — please state briefly) _____

MY PROBLEM: (state here, or in a letter, any specific questions, present problems, unusual or custom-built requirements, special colors or changes of lighting intensity to be included, architectural features such as concrete or steel beams, coves or troffers, etc.)

NAME: _____

POSITION OR TITLE:

PIN THIS FORM TO YOUR COMPANY LETTERHEAD


The tumult and the shouting dies,
The Captains and the Kings depart,
Still stands Thine ancient sacrifice,
A humble and a contrite heart.
Lord God of Hosts, be with us yet,
Lest we forget—lest we forget!
— Rudyard Kipling

To Our Customers and Friends—

You and we have worked together through four of the world's most tragic years. Our common interest in a common cause has strengthened old business friendships and has made many new ones. For this we are grateful.

This experience of mutual respect and confidence is *one* result of the war that will be carried over to the problems of peace. It is the very stuff that will assure profitable business at home and better relations with our neighbors abroad.

We of the Biddle Company fortunately have no factory problem of reconversion. For the most part, we make the same testing instruments for industry at peace as were required for war. And as more of our products become available for industrial and rehabilitation purposes, we will continue to serve you—in good faith always—and to the best of our ability.

JAMES G. BIDDLE CO.
1211-13 Arch Street, Philadelphia 7, Pa.

"MEGGER" INSULATION TESTERS, GROUND TESTERS AND OHMMETERS • "FRAHM" FREQUENCY METERS AND TACHOMETERS • "JAGABI" RHEOSTATS • INDICATING HAND TACHOMETERS • SCIENTIFIC APPARATUS

TRUMBULL

FLEX-A-POWER *with*

"DROP-OFF" CABLE WIRING TO LOAD

The illustration below shows Trumbull's suggested simple method of wiring from Flex-A-Power to machines by means of a "drop-off" cable from the load side of Flex-A-Plugs . . . a method long favored by satisfied users of Trumbull Flex-A-Power . . . and now definitely improved.

By means of a new Spring Suspension device, Trumbull has obtained maximum advantage of the inherent flexibility of Flex-A-Power . . . a basic wiring system in itself. A predetermined length of cable is connected to the load side of Flex-A-Plugs and wired to the load (or machine). The spare or slack is then adjusted through the supporting Spring Suspension device to make the lateral run of cable exactly horizontal and the drop exactly vertical. Thus machine, cable and plug become an integral unit which may be moved at will to meet changing conditions of production. Flex-A-Plugs may be inserted at any point in the Flex-A-Power system.

ADDED ADVANTAGES

The use of the Trumbull Spring Suspension device makes "drop-off" cable wiring an extremely neat installation. The cost of such wiring is low and both new installations and rearrangement of present production facilities are greatly speeded.

TRUMBULL SPRING SUSPENSION DEVICE

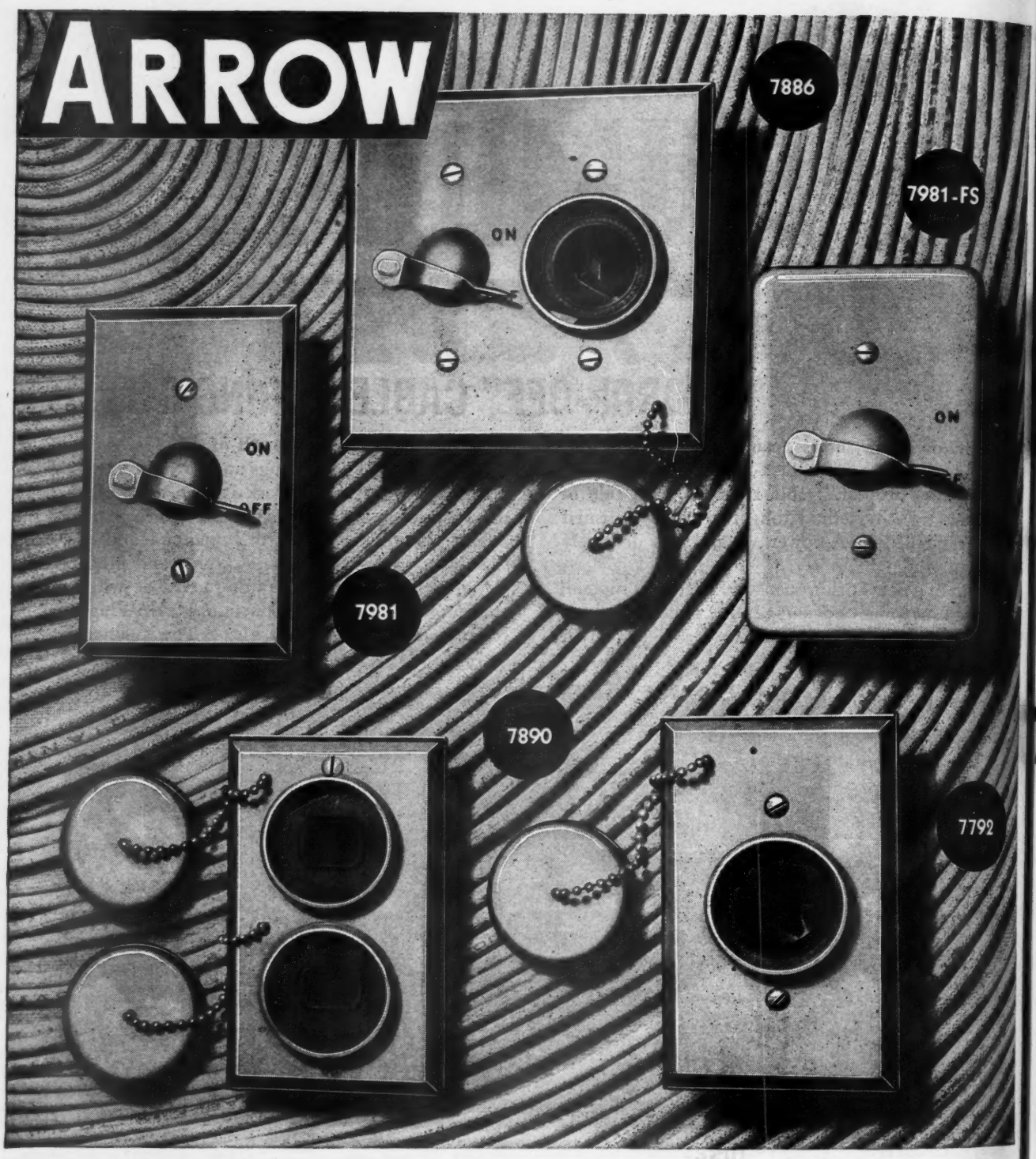
Photograph shows complete assembly of Trumbull Suspension Device and "drop-off" cable. The Suspension Device (at top of assembly) consists of porcelain spool indicator, wire clevis and spring. Made in two sizes, Catalog Nos. CS-3, CS-4.

THE TRUMBULL ELECTRIC MANUFACTURING CO.

PLAINVILLE, CONNECTICUT

OTHER FACTORIES

NORWOOD (CINN.) OHIO — SEATTLE — SAN FRANCISCO — LOS ANGELES



WEATHERPROOF SWITCHES and RECEPTACLES

Designed for outdoor applications—from porches and patios to factory platforms—*and* industrial inside installations subject to excessive moisture. No. 7886,—2-gang unit, single-pole Switch and Receptacle, with cadmium-finished brass plate fitting over weather-tight rubber mat. No. 7981,—Single-pole Switch with cadmium-finished brass plate and weather-tight rubber mat. No. 7981-FS,—Switch for use with "FS"-type fittings for industrial jobs. Aluminum-sprayed steel plate with rounded edges; moisture-tight mat. (Above switches available also in double-pole, 3-way and 4-way.) No. 7890,—Duplex Receptacle with .060" gauge brass plate, metal caps, weather-tight rubber mat. No. 7792,—Single Receptacle with cadmium-finished brass plate, metal cap and weather-tight mat. *Sold through Electrical Wholesalers.* ARROW ELECTRIC DIVISION

THE ARROW-HART & HEGEMAN ELECTRIC COMPANY, HARTFORD, CONN., U. S. A.

SMOOTH...
NEAT...
EFFICIENT...

THAT'S

FLORDUCT

for Power, Light and Communications

EFFICIENT—trouble-free service

STURDY—lifetime wear

EASY TO INSTALL—"La-in" the wires and snap on the capping

NEAT, SMOOTH—does away with unsightly, loose wiring; is inconspicuous and harmonizes with office fittings

RESISTANT TO ABUSE—will withstand mopping, kicking, hand truck and similar traffic

SAFE—electrically safe and mechanically strong

RE-USABLE—can be taken up and re-installed elsewhere

FLEXIBLE FITTINGS—to meet every need

APPROVED BY UNDERWRITERS

Write for complete details

PIONEERS OF SURFACE RACEWAYS

National Electric
PRODUCTS CORPORATION
Pittsburgh 22, Pa.

NATIONAL ELECTRIC PRODUCTS
WIRING & SYSTEMS
WIRES AND CABLES

CENTRAL
RIGID STEEL
CONDUIT

has pleased a lot of people in over 30 years

"There's Tested Strength in Every Length"

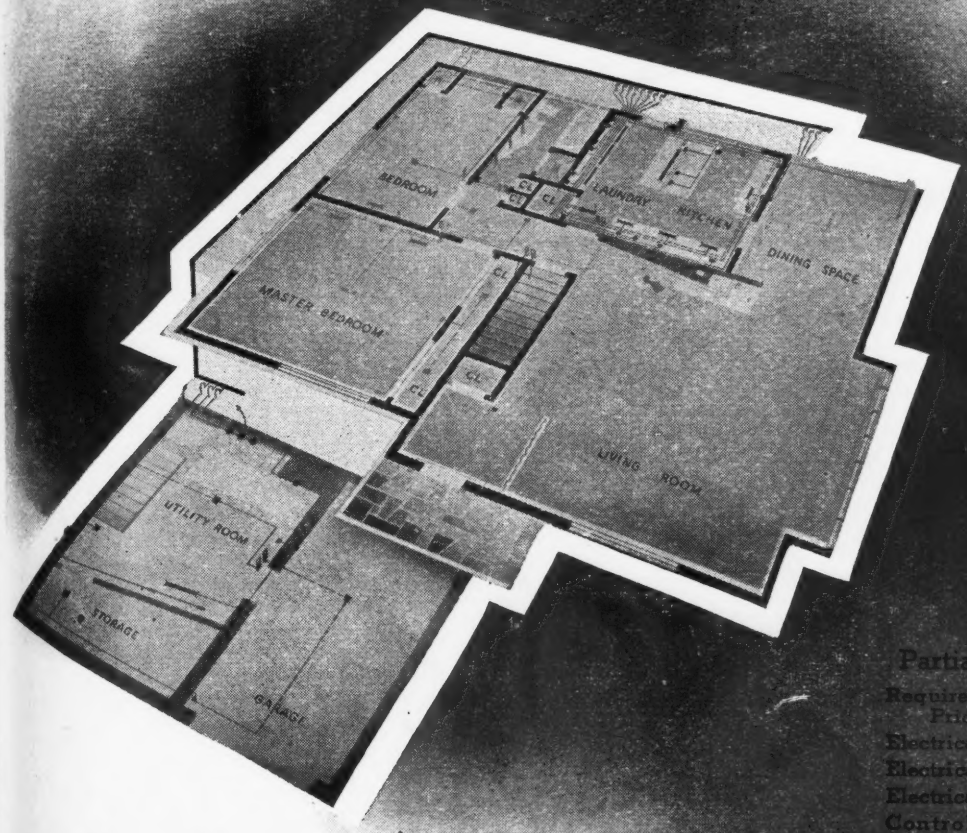
SPANG-CHALFANT

Division of The National Supply Company

General Sales Office: Grant Bldg., Pittsburgh 30, Pa.

District Offices and Sales Representatives in Principal Cities

Avoid 1950 headaches *now!*



The red light on home construction has turned green. Soon we will be right in the middle of a housing boom, the age of electrical living . . . and—unless we act now—headaches in 1950!

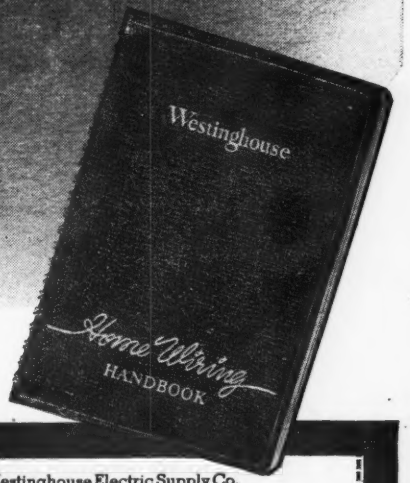
Electrical contractors know that modern homes will be "electrical homes" and that they must be *wire-planned* to meet heavier demands imposed by the greatly increased use of electrical appliances now and in the years ahead. That means "modernization" headaches in 1950 unless these homes are adequately wired today.

Here is where Wesco can help you. Especially prepared for electrical contractors, the new Westinghouse "Home Wiring Handbook" is your best guide to better home wiring, bigger profits for you and fullest satisfaction for the home owner. For how much it will help you, just glance over the partial list of contents on the right. To get your copy, simply fill in the coupon and mail to Wesco with $1.

And for all the materials you need for better home wiring and for deliveries in a hurry, depend on your local Wesco Office.

Partial Table of Contents

Requirements of Four Popular Priced House Groups
Electrical Home Appliances
Electrical Outlets
Electrical Circuits
Control Centers, Feeders and Service Entrance
Conductors, Circuit Protection
Signal Systems, Telephones, Radios
Minimum Specifications
Charts and Tables
Wiring Devices



Westinghouse

Electric Supply Company

NATIONAL DISTRIBUTING ORGANIZATION

for everything electrical — *Wesco*

Westinghouse Electric Supply Co.
Box 25, Wall St. Sta., 40 Wall St., New York 5, N.Y.

Gentlemen: Please send me my copy of the new Westinghouse Home Wiring Handbook. I enclose $1 in full payment.

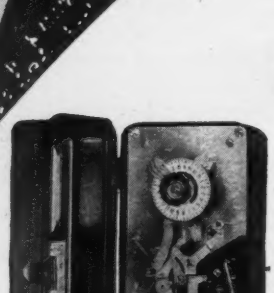
Name.....
Company.....
Address.....
City & Zone.....
State.....

Sangamo

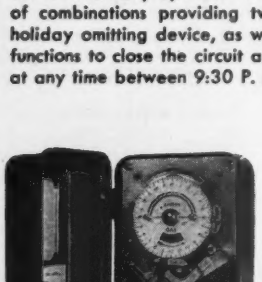
TIME SWITCHES

FORMS KA AND KAZ—SYNCHRONOUS MOTOR—SILVER CONTACTS

Six levers are provided for a maximum of 3 daily "on" and "off" operations. Accurate timing is obtained by turning the minute hand reset staff on the 24 hour dial. If desired the time-switch can be manually operated without affecting subsequent operations. Available in a wide variety of combinations providing two-circuit, duplex, and outdoor switches; also with Sunday and holiday omitting device, as well as advanced time cutoff. The KAZ Astronomic Dial Time-Switch functions to close the circuit at sunset and open it at sunrise, or the "off" operation may be set at any time between 9:30 P. M. and 2:15 A. M.



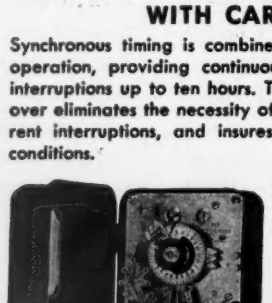
FORM KA



FORM KAZ

FORM VSW—SYNCHRONOUS MOTOR—WITH CARRYOVER

Synchronous timing is combined with reserve spring clock operation, providing continuous operation during current interruptions up to ten hours. This entirely automatic carry-over eliminates the necessity of resetting the dial after current interruptions, and insures accurate timing under all conditions.



FORM VSW

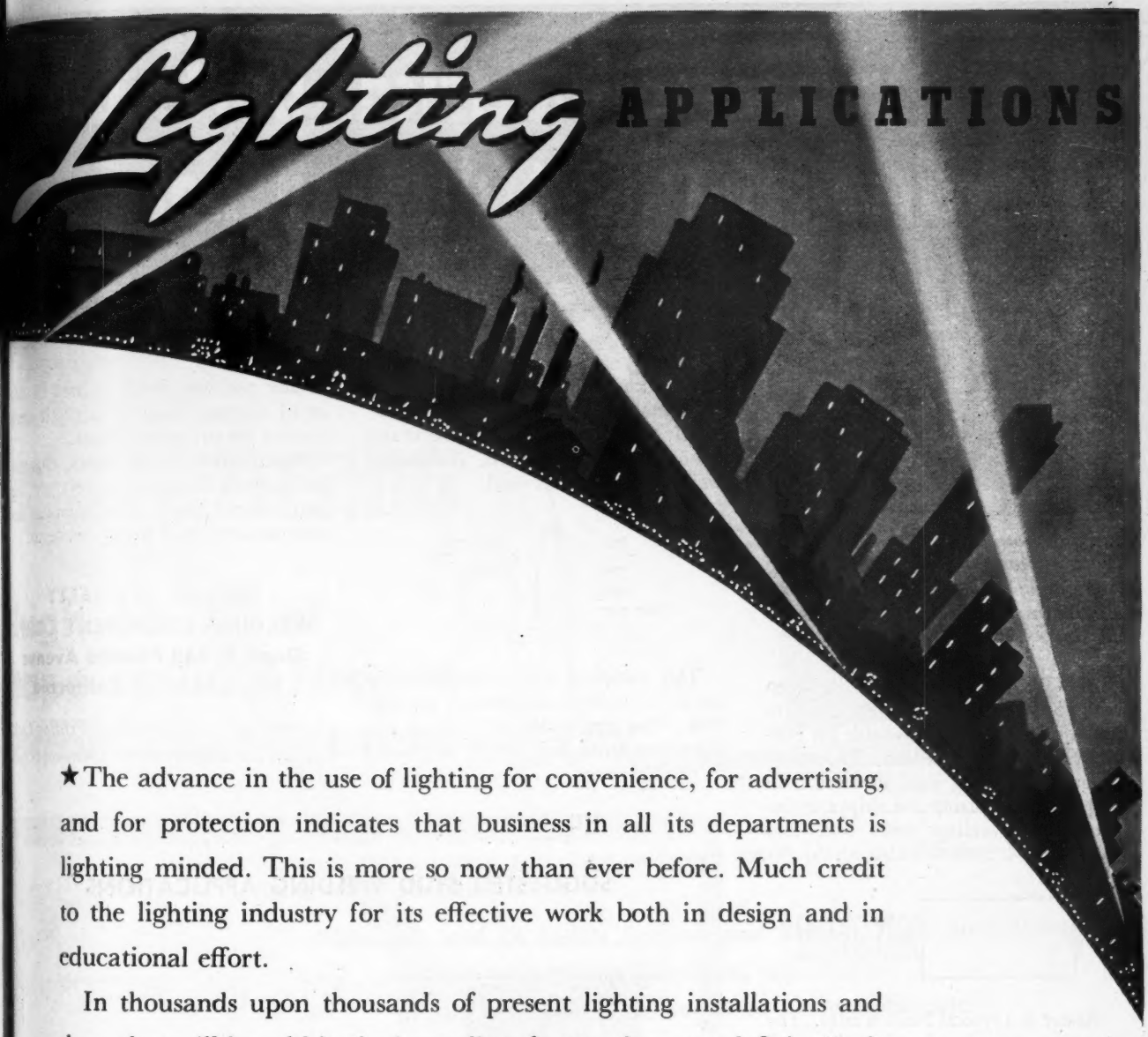
ASTRONOMIC DIALS

Efficient control of window lights, bill-boards, and street lighting can be best accomplished by use of a Sangamo Time-Switch equipped with an Astronomic Dial. This allows "on" and "off" operations to accurately follow sunset and sunrise time.

New Business
ERA AHEAD SUGGESTS IMMEDIATE INVESTIGATION
Write for Catalog

SANGAMO ELECTRIC

ESTABLISHED 1898 • • • MICA CAPACITORS • • •



★The advance in the use of lighting for convenience, for advertising, and for protection indicates that business in all its departments is lighting minded. This is more so now than ever before. Much credit to the lighting industry for its effective work both in design and in educational effort.

In thousands upon thousands of present lighting installations and those that will be sold in the immediate future, there are definite "on" and "off" periods. These applications are broadened by the convenience of Time-Switch control. For example, billboards, floodlighting, show windows, airports, lobbies, and many other installations.

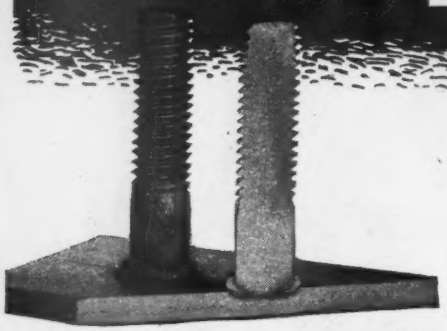
SANGAMO TIME SWITCHES, service-proved over years, definitely answers the important "on" and "off" requirements so necessary in lighting. Here is AUTOMATIC CONTROL that is dependable at all times.

It is easy enough to interest users of lighting in this convenience measure—buyers of lighting installations see the value of Automatic Control—it's an ever-broadening sales opportunity.

COMPANY SPRINGFIELD ILLINOIS

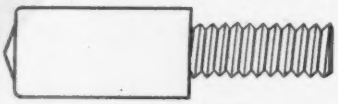
• • • WATT HOUR METERS • • • TIME SWITCHES • • •

How to secure electrical parts and wiring without drilling holes

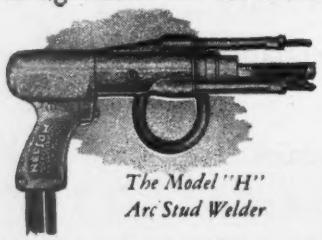


This section view of a stud weld shows how Nelson Stud Welding completely fuses a stud to metal, eliminating drilling holes. And it's all done automatically!

NELSON Arc Stud Welding has been used for years for marine electrical installations and is now available for general electrical construction. Thousands of guns are being used in more than 800 industrial plants and shipyards because stud welding saves *time* and *material.*

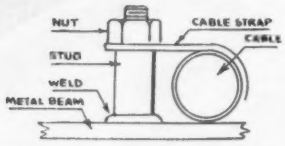


Above is a typical Nelson Stud. The pointed end is placed against the metal part and welded with the stud gun. The electrical parts are secured to the threaded end. Studs are manufactured in all standard lengths up to eight inches, in diameters from $\frac{3}{16}$" to $\frac{3}{4}$", and in many types and shapes. It takes less than *one second* to weld a Nelson Stud — operators secure 500 to 1000 studs in eight hours without difficulty.



The Model "H" Arc Stud Welder

The timing and operation are automatic and the use of the equipment is simple. The operator places a stud in the chuck of the gun, places it against the metal, and pulls the trigger. Instantly the arc fuses stud and metal and the operation is completed. A standard welding generator is used.



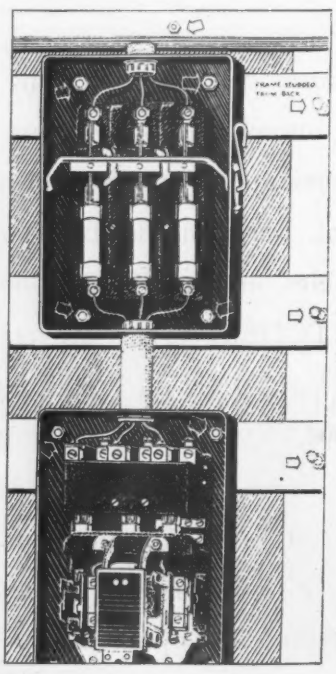
This complete stud assembly *(also see below)* shows the general application. One gun welds all lengths and diameters, producing a full fillet weld in any position. Studs secured by this rapid method equal in strength those secured by any other means.

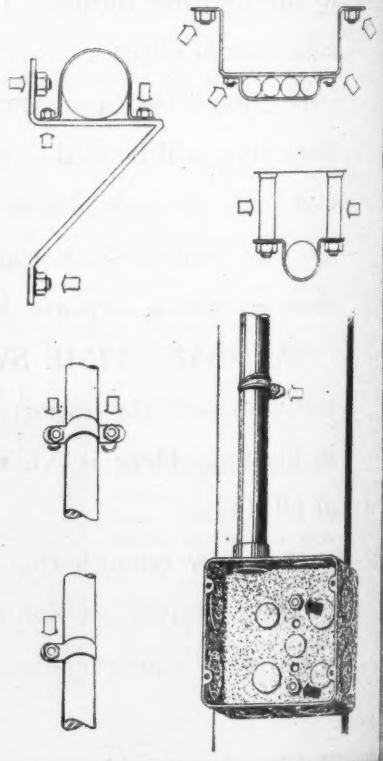
Switchboxes, outlet boxes, channels and gutters, inspection covers, etc., are also secured easily. For complete details, catalog, and prices, write to:

NELSON SPECIALTY WELDING EQUIPMENT CORP.
Dept. F, 440 Peralta Avenue
San Leandro, California

Eastern Rep.: Camden Stud Welding Corp. 1416 South Sixth Street, Camden, N. J.

SUGGESTED STUD WELDING APPLICATIONS





NELSON ARC STUD WELDING

TRADE ADVERTISING

high on list of tape-selling factors according to recent survey

PANTHER
BLACK
DRAGON
SPECIFICATION
97%
reported company age and reputation most important buying factor!
A number of commercial tape agents were recently asked to list the most important factors in the purchase of friction and rubber tape. Almost unanimously they reported the above results.
On both these points, PANTHER and DRAGON Friction and Rubber Tapes stand high
They are made by a company in the electrical insulation business since 1878.
They are compounded and produced by the same research chemists and skilled workers that make world-famous Okonite and Hazard wire and cable products.
PANTHER and DRAGON Friction Tapes adhere firmly and have high adhesive characteristics. PANTHER and DRAGON Rubber Tapes fuse readily and securely and have high elongation and excellent electrical qualities. All tapes pass ASTM and Federal Emergency Specifications.
For complete information on these tapes – or for the address of your nearest recognized distributor – write today.
PANTHER & DRAGON
friction and rubber TAPES
Sold Through Recognized Independent Wholesalers
HAZARD
INSULATED WIRE WORKS
Division of The Okonite Co.

According to a recent poll, tape salesmen rated trade advertising high on the list of effective selling helps.

PANTHER and DRAGON Friction and Rubber Tape advertising is reaching important tape buyers through national and sectional trade publications

Also strongly backing up this trade advertising program is imprinted promotional material available to wholesalers and retailers for distribution by mail to their customers.

There's more than dealer help to recommend PANTHER and DRAGON Friction Tapes. They adhere firmly and have high adhesive characteristics. PANTHER and DRAGON Rubber Tapes fuse readily and securely, have high elongation and excellent electrical qualities. All tapes pass ASTM and Federal Emergency Specifications.

For complete information on these tapes – or for the address of the nearest agent – write today.

PANTHER & DRAGON
friction and rubber TAPES
Sold Through Recognized Independent Wholesalers
HAZARD
INSULATED WIRE WORKS
Division of The Okonite Co.
Wilkes-Barre, Pennsylvania • Offices in Principal Cities

Now flying coast-to-coast for the first time, Northwest Airlines will add thousands of passenger-miles to its log and hundreds of maintenance operations to its shop schedules. A great majority of these vital maintenance jobs will be speeded by Thor Portable Electric Tools . . . the tools that Northwest relies on for fast, dependable service.

Light in weight and compact in design, Thor Tools provide greater power per pound and small size for easy handling on tough jobs. They can save time and money for you just as they are doing for Northwest Airlines and thousands of other users—from coast to coast.

INDEPENDENT PNEUMATIC TOOL COMPANY

600 West Jackson Blvd., Chicago 6, Illinois

New York Los Angeles

Branches in Principal Cities

NEW, up-to-date catalogs on Thor Electric Tools are ready now. Write for your copy today.

LIGHTER . . . FASTER
A TOOL FOR EVERY JOB!

Small, light, powerful, Thor ¼" capacity Electric Drills are made in five different speeds . . . 14 models for application to any job in all materials.

Half the Weight . . . in Half the Space—that's the Thor U44 half-inch Electric Drill. And it has all the power of tools twice its size! Other Thor Drills in capacities up to 1½ inches.

More Power in Every Blow with the Thor U100 Electric Hammer. Weighs just 14 pounds and has a capacity up to 1 inch star drills for use in stone, wood or metal.

14 Basic Models of Thor Electric Screwdrivers and Nut Setters . . . with dozens of special attachments means a tool for any assembly job to speed work and cut costs.

Industrial Sales and Service are Easier with MITCHELL LIGHTING

HERE'S WHY!

1. MITCHELL fluorescent fixtures assure more abundant, more efficient light for industrial workers.

2. Greater mounting flexibility simplifies installation of single units or continuous rows.

3. Easier, lower-cost maintenance saves time and money.

4. Rugged construction assures longer, more dependable service.

5. Complete MITCHELL line provides a ready answer for every industrial lighting need. 2-40, 3-40 and 2-100 watt models, in open-end and closed-end types, including "Instant Start." RLM and FLEUR-O-LIER Certified.

Industrial users are quick to discover these benefits. As a result, you have the edge on competition . . . make sales easier . . . build volume business.

Alert Distributors and Contractors in every part of the nation are planning tomorrow's profits . . . *with MITCHELL.*

Makers of Industrial and Commercial
Fluorescent Lighting Equipment
Store Window Lighting
Spotlights and Floodlights • Desk Lamps
Portable Floor and Table Lamps
Bed Lamps
Ultraviolet and Infrared Health Lamps
Residential Lighting Specialties

MITCHELL RLM

USE THESE SALES AIDS!

Write for full-size Catalog No. 281 and Pocket-size Catalog No. 290. Each tells full story of Industrial units . . . creates business for you.

MITCHELL
FIRST IN POPULARITY

Mitchell Manufacturing Company
2525 CLYBOURN AVENUE, CHICAGO 14, ILLINOIS
West Coast Factory and Sales Office: 1019 N. Madison Ave., Los Angeles 27, Cal.

Cooler Cables!

LABORATORY TESTS PROVE:

TRANSITE DUCTS DIFFUSE HEAT FASTER!

FROM LABORATORY TESTS lasting more than two years comes proof of the superior heat-dissipating qualities of Johns-Manville Transite Ducts.

By applying the data from the tests to specific field conditions, J-M Engineers have determined the comparative I^2R losses of underground ductways in actual operation. They have found, as a result of a number of such studies, that Transite Ducts dissipate these losses up to 13% faster than the other ductways tested.

It is apparent, therefore, that cables in Transite Ducts have a higher inherent load capacity. Or, carrying rated loads, cables will run cooler, thereby reducing copper losses and increasing cable insulation life.

Transite Ducts are strong, immune to rust and rot, incombustible, not affected by electrolysis or galvanic action. Smooth bore makes possible long cable pulls and easy replacements. Long, lightweight lengths can be quickly installed. And, a variety of fittings simplifies even the most complicated installations.

For full information write for Data Book DS-410, Johns-Manville, 22 East 40th Street, New York 16, New York.

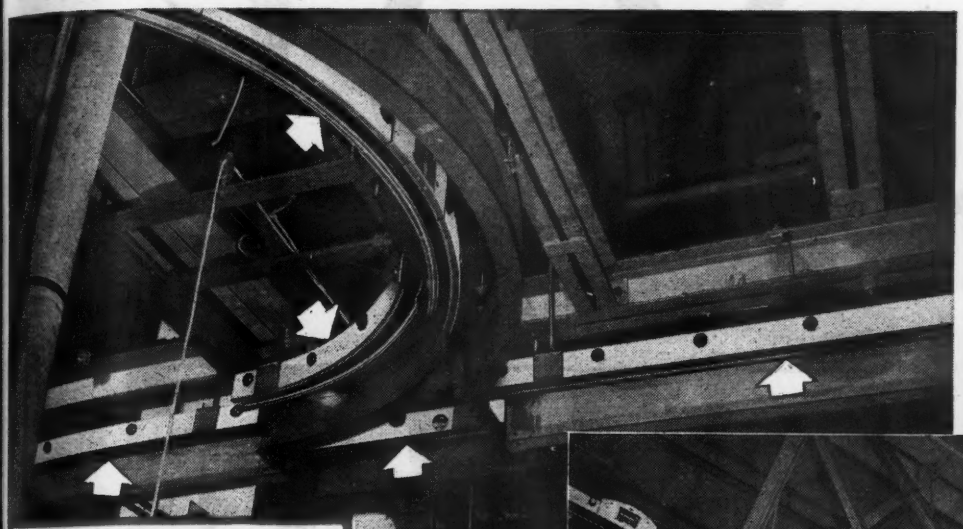
Johns-Manville ***TRANSITE DUCTS***

CONDUIT for use without concrete

KORDUCT for concreting in

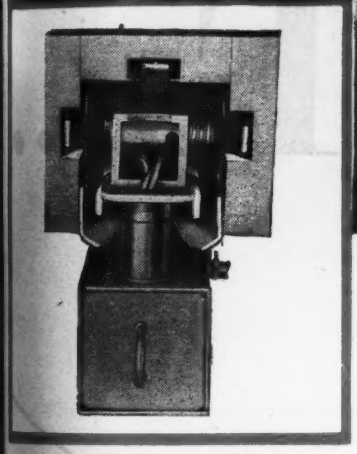
JOHNS-MANVILLE JM PRODUCTS

BULLDOG *DEVELOPMENT* SPEEDS PRODUCTION!

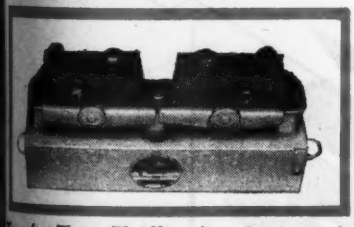


Monorail Hoist switching application; switching from curved to straight Industrial Trol-E-Duct run.

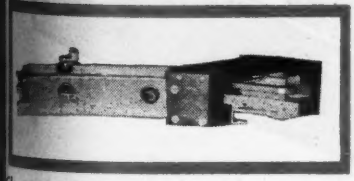
Transfer Crane and Hoist installation using flared ends Industrial Trol-E-Duct and Transfer Type Trolleys.



Cross sectional view of Flared End Duct and Transfer Trolley.



Transfer Type Trolley for Crane and Hoist transfer or switching.



Close-up of Flared End for Curved Industrial Trol-E-Duct.

CRANE AND HOIST SWITCHING AND TRANSFER PROBLEMS SOLVED!

Again BullDog pioneers a new and better way for transferring loads mechanically and electrically from crane bays to individual factory areas. Monorail transfer and switching is also made easier and more flexible.

This is accomplished by electrical Transfer Trolleys with swiveled heads moving through Duct runs having flared ends to facilitate transfer to similar runs in adjacent bays.

In these installations straight or curved runs of electrical Trol-E-Duct are attached to and move with the Crane and Hoist equipment to furnish a safe, smooth and speedy means of transferring or switching material to or from any part of the plant.

Your Crane and Hoist jobs will run smoother, safer and speedier in conjunction with these improved features of Industrial Trol-E-Duct.

BullDog field engineers are available for consultation—or write us if you prefer.

BULLDOG

ELECTRIC PRODUCTS COMPANY

DETROIT 32, MICHIGAN.
In Canada:
BullDog Electric Products of Canada, Ltd., Toronto.
Field Offices in All Principal Cities.

Also Manufacturers of
SafToFuse Panelboards—Switchboards—Circuit Master Breakers—Universal Trol-E-Duct, for flexible lighting—Industrial Trol-E-Duct, for movable "loads"—BUS-tribution DUCT, for "Plug-In" Power.

LOOK HERE...

for finer fluorescents

WESTINGHOUSE PRESENTS *John Charles Thomas, Sunday 2:30 P. M., E. S. T.—N. B. C. Tune in Ted Malone, Monday through Friday, 11:45 A.M., E.S.T.—Blue Network.*

© 1945 Westinghouse Electric Corporation

TODAY there are no finer fluorescent lamps

to be obtained than those which come out

of the Westinghouse package.

TOMORROW, when further research results in

even finer fluorescents, they too

will come out of a Westinghouse package.

WHY? Because no-one knows

better than Westinghouse how

to make lamps. No-one has

better facilities for control of

raw materials, for research, for continually

improving manufacturing techniques, for rigid

schedules of inspecting and testing.

So, to bring your sales of lamps to the highest

profit peak, it's only natural to

look to Westinghouse!

Westinghouse

PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE

LAMPS FOR SEE-ABILITY

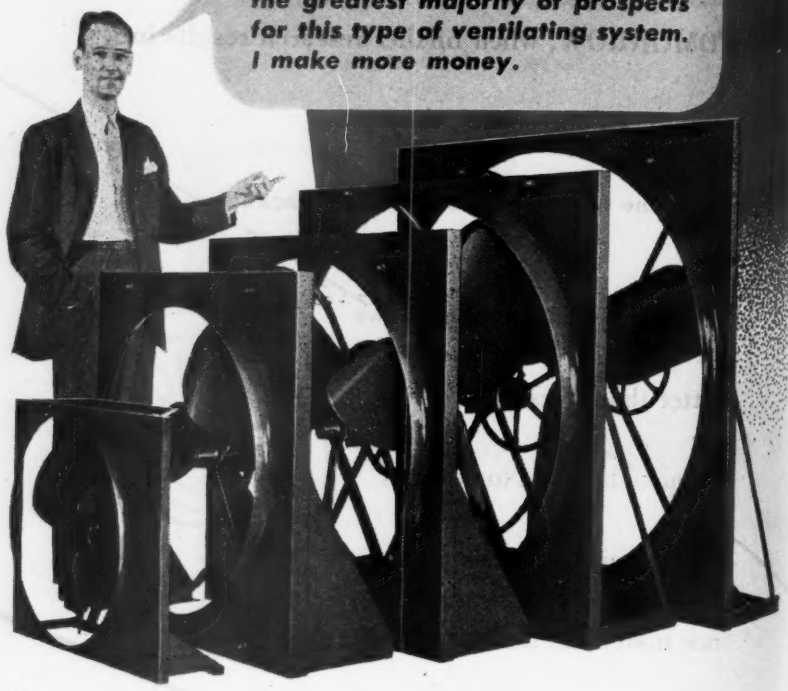
LAU PROPELLER-TYPE (Niteair) FANS

are available in

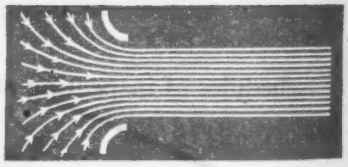
5 DIAMETER SIZES

with a range of 8 discharge capacities

With the Lau line, I tie up less cash in fans. I keep all sizes on the floor for ready installation of any one particular size. With minimum investment and inventory, I satisfy the greatest majority of prospects for this type of ventilating system. I make more money.



Lau propeller-type fans have many applications in industrial plants, stores, offices, and homes—providing a constant supply of fresh air by removing stale, excessively hot, or dust-laden air; fumes; or smoke . . . circulating cool night air through living and sleeping rooms for greater summer comfort. Governmental restrictions on the manufacture and sale of blowers and fans have been removed, but it appears that shortages of steel and motors will continue to exist for an indefinite time. We suggest that you discuss your 1946 requirements at the earliest possible moment. *Write us direct or contact your jobber.*



VENTURI-TYPE HOUSING ENTRANCE

New "Streamlined" Feature reduces air "drag" and turbulence. Assures increased delivered volume with less power. Eliminates most common cause of "air noise."

Numerous Other Lau Features—

Self-Aligning Bronze Bearings
Advanced Blade Design
for greatest air delivery
Rigid All-Steel Construction
All parts made by Lau
(except motors and belts)
Large Oil Reserve
Quiet Operating Motor
Mass produced
Low Unit Cost

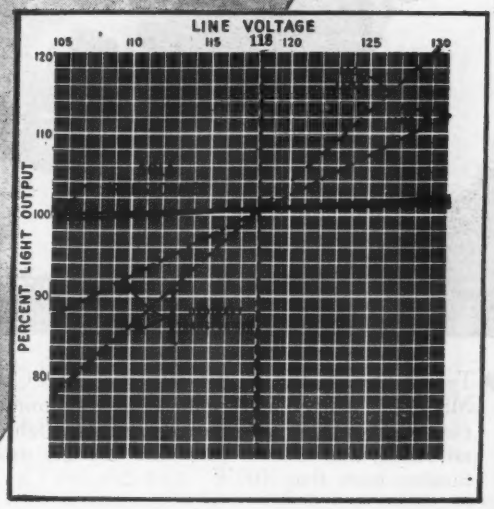
THE **LAU BLOWER COMPANY**

DAYTON 7, OHIO, U. S. A.

WORLD'S LARGEST MANUFACTURER OF FURNACE BLOWERS

Engineers and fabricators of general Air Handling Equipment • Single Inlet and Double Inlet Blowers • Propeller Fans • Accessories

Whatever the FLUORESCENT light source, there is a SOLA TRANSFORMER or BALLAST to meet every requirement



Selection of the proper light source for particular applications of fluorescent lighting is no longer a simple assignment. Lighting research and development have produced a wider choice, each possessing its own qualifications and requirements.

But regardless of the light source selected there is a SOLA Fluorescent Ballast or Transformer that has been engineered specifically for the requirements of each type of fluorescent lighting.

Many of these fluorescent lamp auxiliaries have been designed around the *new* SOLA Constant Voltage principle. This patented circuit provides regulation to the lamp that was never before possible. With this new added feature, lumen output of lamps can be maintained at calculated levels regardless of fluctuations that are constantly occurring in the primary voltage supply. This maintenance of lumen output represents a definite saving to the user and positive insurance to the lighting engineer of constant footcandles on the working surface.

Whatever your lighting requirements, consult SOLA engineers—they have the answer to the many fluorescent lighting problems that are daily confronting the lighting engineer.

\+ + +

SOLA fluorescent Lighting Transformers incorporating the Constant Voltage principle are covered by United States Patents Nos. 2,143,745 —2,212,198—2,346,621.

SOLA
Lighting Transformers

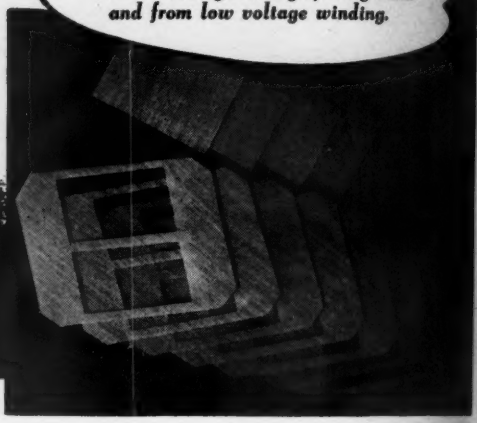
4 Important Bulletins available on request

COLD CATHODE	Bulletin	JCC-104
COLD CATHODE	Bulletin	JCC-107
FLUORESCENT	Bulletin	JFL-108
FLUORESCENT	Bulletin	JFL-110

Transformers for: Constant Voltage • Cold Cathode Lighting • Mercury Lamps • Series Lighting • Fluorescent Lighting • X-Ray Equipment • Luminous Tube Signs Oil Burner Ignition • Radio • Power • Controls • Signal Systems • etc. **SOLA ELECTRIC COMPANY, 2525 Clybourn Avenue, Chicago 14, Illinois**

NATVAR INSULATED *Redmond* DYNAMOTORS *Meet Flight Conditions*

Natvar VC is furnished in two shapes, punched to Redmond's dimensions and angular specifications. The window-like piece insulates end turns between high voltage coils; the rectangular piece insulates high voltage from ground and from low voltage winding.



● Type 8 Dynamotors built by the Redmond Company, Inc., Owosso, Michigan, deliver high voltage for electronic equipment in fighter planes. They must be extremely durable, light to the last fraction of an ounce, and able to withstand changes in ambient temperatures ranging more than 160°F

BEFORE Redmond Dynamotors fly, they are put through temperature, humidity and corrosion tests exceeding anything found either in the Tropics or in the Arctic. Electrical tests are equally rigid. Ground tests are made at 1750 volts.

Insulation must be top-quality — light in weight, but high in dielectric strength; extremely uniform, and accurately punched. Natvar Special Thin Varnished Cambric is consistently meeting these requirements.

We are interested in your requirements. Write, wire or phone us for deliveries, either from nearby wholesalers' stock or from our own.

Natvar

- Varnished cambric — straight cut and bias
- Varnished cable tape
- Varnished canvas
- Varnished duck
- Varnished cellulose acetate
- Varnished special rayon
- Varnished Fiberglas cloth
- Varnished papers
- Varnished tubings and sleeving
- Varnished identification markers
- Lacquered tubings and sleevings
- Extruded vinyl tubing
- Extruded vinyl identification markers

Write for Catalog No. 20

THE NATIONAL VARNISHED PRODUCTS *Corporation*

TELEPHONE
RAHWAY 7-2171

CABLE ADDRESS
NATVAR: RAHWAY, N. J.

205 RANDOLPH AVENUE ★ WOODBRIDGE NEW JERSEY

MORE SALES AND PROFITS FOR YOU

Production of Electromodes Doubled for This Season

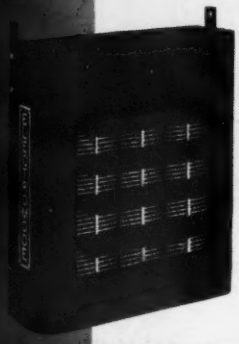
•

The All-Electric Unit Heater

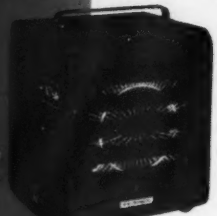
•

Nationally Advertised in Leading Industrial Publications

Easily Installed—Safe—Economical



Models 10 to 60 KW are for suspension mounting only.



The 1.5 to 7.5 KW models are for either portable use or suspension mounting.

Last year's deliveries of Electromode Heaters to industry had to be restricted because of the continued heavy demand by both Army and Navy. Recently, however, it has been possible to divert more of our facilities to production for general use and Electromodes are now available in greater quantities.

Already, many leading wholesalers are selling Electromode Unit Heaters and additional deliveries will be made as quickly as possible to all who place their orders early.

Electromode Unit Heaters have enjoyed increasing sales popularity because they feature *All-Electric,* safe heating with flexibility of application and the exclusive patented Electromode Heating Element. This is the same Element which has proved so reliably safe in the heating of U. S. Submarines.

Capacities of Electromodes range from the small 1.5 KW, for either suspension or portable mounting, to the 60 KW designed for suspension mounting only. They are simple to install—just like an electrical fixture—wherever circuit wires can be run. Furthermore, there are no piping or piping connections to maintain, and no heat-loss en route to heaters. Electromodes are 100% efficient from every heating standpoint and they assure you of 100% goodwill with every sale plus plenty of repeat business. ELECTROMODE CORPORATION, Div. of American Foundry Equipment Co., 434 South Byrkit Street, Mishawaka, Indiana.

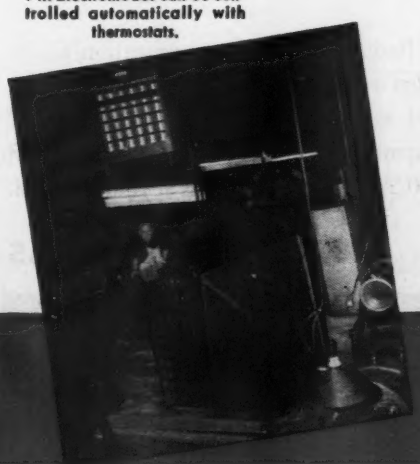
THE HEART
OF ELECTROMODES
Electromodes owe their great efficiency, long life, freedom from fire or explosion hazard to the patented heating element. There is no oxidation, no exposed glowing wires because the resistor is encased in a tubular sheath which, in turn, is totally embedded in a one-piece, finned aluminum casting.

ELECTROMODE
Electric Unit Heaters

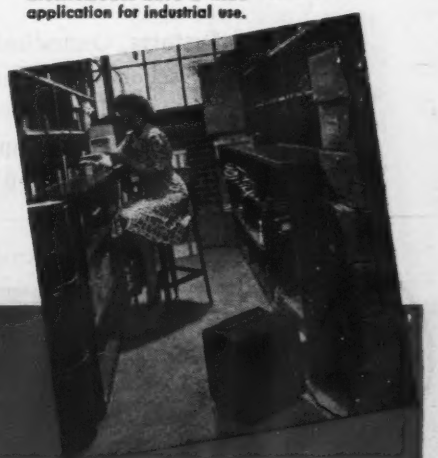
New illustrated Bulletin 45-U just off the press. Copy sent on request.

No fuss, no noise, no maintenance with Electromodes—just good clean heat.

All Electromodes can be controlled automatically with thermostats.



Electromodes have a wide application for industrial use.



MODERN SCHOOLS

USE RCA SOUND SYSTEMS FOR ESSENTIAL TEACHING AID

RCA Sound Systems provide simple and efficient means for instant distribution of radio programs, recordings and lectures to any or all rooms in the school... *Sound Amplification* in auditorium, lunchroom, assembly hall, gym or playground brings entertainment or instruction to a larger audience... *Intercommunication Facilities* place the school administrator, staff and faculty members in instant touch with each other... *Emergency Instructions*, issued in case of fire or accident, may prevent injury or loss of life... *Paging and Special Announcements* over an RCA Sound System save time and effort.

RCA Sound Systems, Centralized Radio and Intercommunication Facilities—for every school need. Design sound into your plans for new or remodeled structures. If you need assistance with your project, write Department 70-138BR, Sound Equipment Section, Radio Corporation of America, Camden, New Jersey. An RCA Sound Specialist is at your disposal.

RCA SOUND SYSTEMS

RCA

RADIO CORPORATION OF AMERICA

RCA VICTOR DIVISION · CAMDEN, N. J.

LEADS THE WAY . . . in Radio . . Television . . Tubes . . Phonographs . . Records . . Electronics

70-6036-138

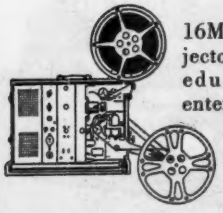
RCA SCHOOL SOUND EQUIPMENT

Control console—contains radio, phonograph and microphone, control and selector switches.

Speakers—wall-cabinet and flush-mounted type for inside use; horn-baffle type for outdoor use.

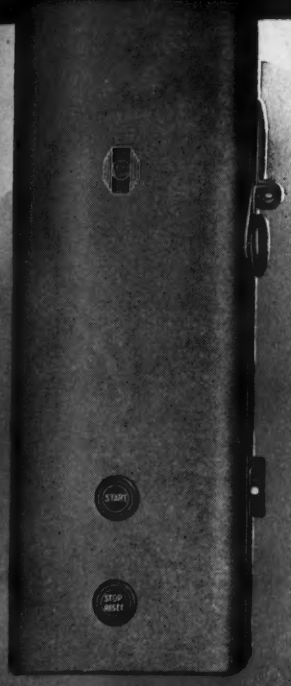
Microphones—dynamic and velocity types in either table or floor-stand mounting.

Intercom units—for communication between key persons or departments.



16MM Sound Projector for showing educational and entertainment films in classroom or auditorium.

"3C" Bulletin 6018 COMBINATION STARTERS

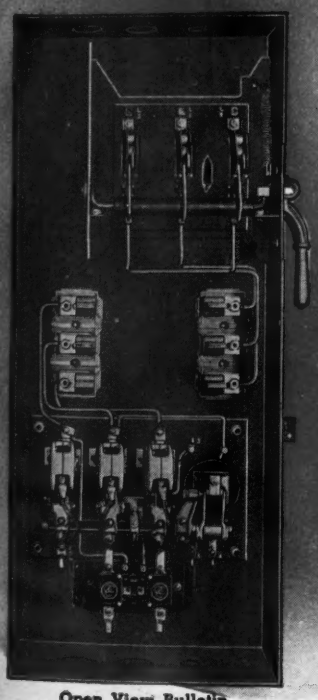


Closed View, Bulletin 6018, Form MC

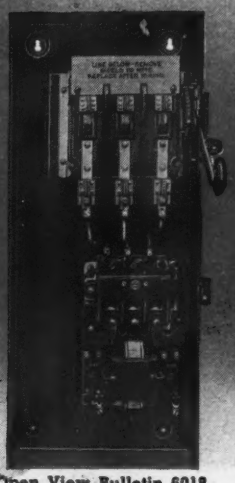
CUT SPACE REQUIREMENTS!
REQUIRE LESS WIRING!
CUT INSTALLATION TIME!
REDUCE MAINTENANCE!

In one streamlined cabinet, Clark Bulletin 6018 Combination Starters combine *Motor Starter*—Across-the-line—with Overload protection, *Fusible* or *Non-Fusible* Safety Switch, also Control Circuit *Transformer* when desired. Designed for any squirrel cage motor application—with a range of 110 to 550 volts. Features include:

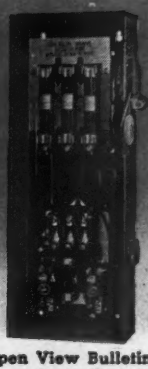
- Plenty of space for easy wiring, but no space wasted.
- Type A Disconnect Switches with fully interlocked cover.
- Four NEMA Type Enclosures: Type 1—General Purpose, Type 1A—Semi Dust Tight, Type 5—Dust Tight, and Type 7—For Class 1, Group D, applications.
- All line contacts are shielded for safety.
- Starter Units have double-break silver alloy contacts.
- Vertical-lift hinged armature magnet will not close from accidental jarring.
- Non Carbonizing arc-shield material withstands high temperature.
- Eutectic Alloy Type Thermal Overload Relays with external reset.
- Enclosed Heaters prevent stray air currents from influencing tripping time lag.
- Overload Relays will not trip out unnecessarily on normal starting or non-injurious overloads.



Open View Bulletin 6018, Size 3, Fusible



Open View Bulletin 6018, Size 2, Fusible



Open View Bulletin 6018, Sizes 0, 1, Fusible with Transformer

Ask your "3C" Distributor for Bulletin 6018 Combination Starters

THE CLARK CONTROLLER CO.

1146 EAST 152nd ST., CLEVELAND 10, OHIO • EVERYTHING UNDER CONTROL

Certified
FLEUR-O-LIER
CERTIFIED
in accordance
with Test
Requirements of
Specifications of
Fleur-O-Lier Manufacturers
CERTIFIED
ETL
ELECTRICAL TESTING
LABORATORIES, INC.
NEW YORK, N. Y.
Certifying Agent
...you
Certified Ballasts and
Starters are an important part
of Fleur-O-Lier Certification.

WHEN FIXTURES WEAR THIS LABEL

have lots of extra selling punch

Just look at the advantages the Fleur-O-Lier label gives you . . . because it signifies fixture features that mean top performance . . . long-lasting customer satisfaction.

1. **Built to authoritative specifications.** Fleur-O-Liers must meet definite standards . . . to provide the best in lighting and lamp performance, plus dependable service.

2. **Tested and Certified by Electrical Testing Laboratories, Inc.** Sample fixtures are taken at random and rigidly checked by ETL before certification. And periodic re-checks give extra assurance of long enduring satisfaction.

3. **Equipped with Certified Ballasts and Starters.** This means better lamp performance, as leading tube makers recognize . . . and so do your customers.

4. **Benefited by the latest developments in fluorescent . . .** since this testing and research service brings you the accumulated knowledge and research of many of the finest technicians in fluorescent lighting.

5. **Produced by more than 30 leading makers.** Fixtures made by more than 30 of the leading manufacturers have won the right to wear this famous Fleur-O-Lier label. That means many sources of supply . . . variety in types and styles . . . *with known quality.*

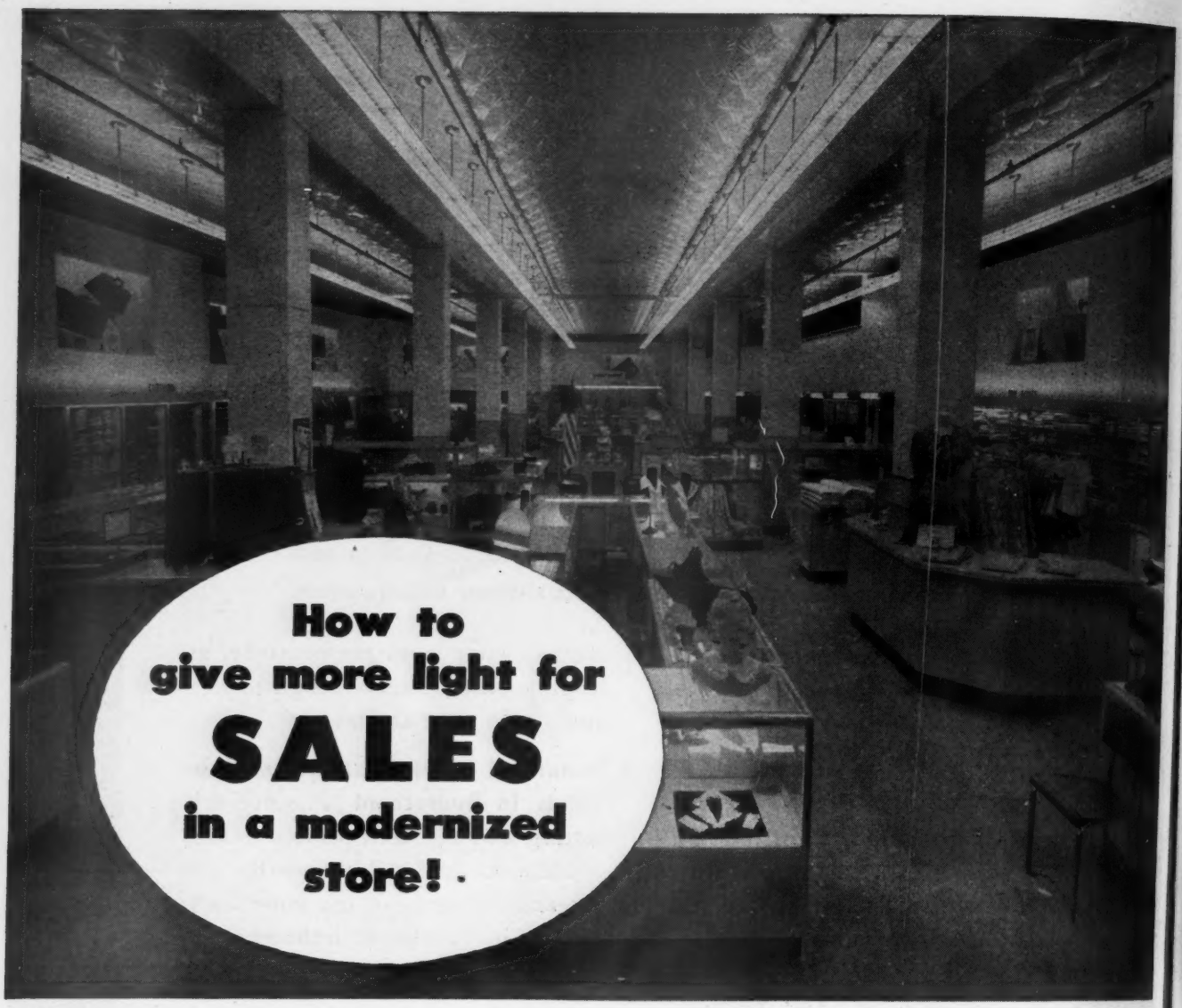
Plan for bigger fluorescent lighting sales tomorrow . . . and make fixtures marked Certified Fleur-O-Lier part of your plans!

FLEUR-O-LIER

Manufacturers

CERTIFIED FIXTURES FOR FLUORESCENT LIGHTING

Participation in the FLEUR-O-LIER MANUFACTURERS' program is open to any manufacturer who complies with FLEUR-O-LIER requirements



How to give more light for SALES in a modernized store!

Wanted:

Inviting, inconspicuous, overall modern light. Lighting as smart and pleasing as the modernized Griswold section of Strouss-Hirshberg's Warren, O., store.

Problem:

A minimum of structural change was desired. The ceiling had many irregularities. And a low balcony indicated the use of shallow units.

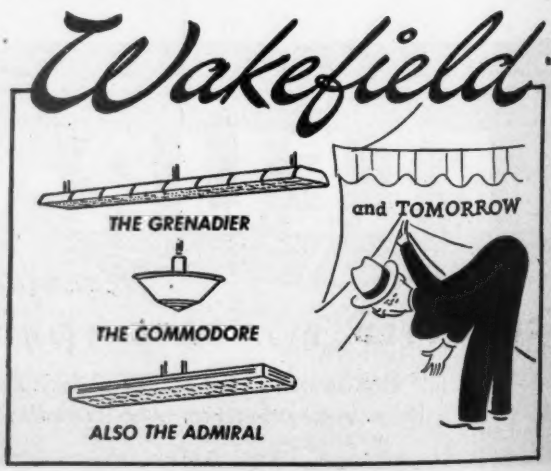
Solution:

Continuous rows of Wakefield GRENADIERS (No. PG-2488) to provide good selling light on merchandise and cheerful, pleasing light on walls and ceiling for greater eye comfort in the store.

Since GRENADIERS can serve as a wiring channel for conduit, a minimum number of outlets were necessary. The hanging flexibility of these units made it easy to compensate for slight ceiling irregularities. And their shallow depth permitted GRENADIERS to be used on the low balcony and in the low area below it, as well as in the main store space.

Your customers may have different problems; need different fixtures. But you can be sure of this: Wakefield will be glad to work with you for engineered lighting to fit. The F. W. Wakefield Brass Co., Vermilion, Ohio.

Are your customers throwing away DOLLARS? *Proper lighting maintenance—cleaning fixtures and walls and relamping—can double or triple their light. Urge them to get the lighting value they pay for. It's important to you!*



A fast way to get motors...

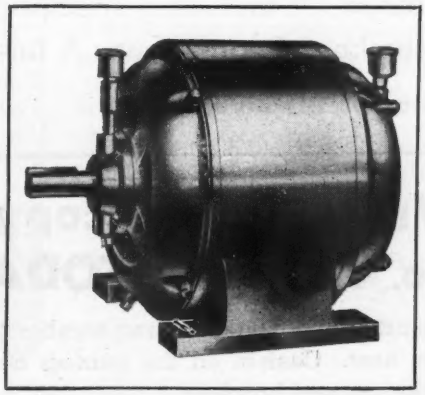
This suggestion is not addressed to buyers who use standard motors, although for them Star also has good news: Star began production of a large range of standard motors for stock weeks ago, and early delivery of some of these can be made.

To makers of products which require a motor that is somewhat "special" in frame design or mounting arrangement, Star's Welded Steel Construction may be a time-saver of great importance *right now.*

Star pioneered this method of construction, and developed unique production welding facilities to save the time and money that went into patterns and castings once required for "special motor" customers.

Exceptional strength and shock resistance is also gained through Star's Welded Steel Construction. This led to extensive use of Star Motors by the Navy long before the war.

A number of prominent concerns, needing motors that vary from standard, have found that Star can help them to get motors faster than they thought possible. Star may be able to reduce *your* wait for motors. To find out, send a description of your requirements to Star Electric Motor Co., 219 Bloomfield Avenue, Bloomfield, New Jersey.



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All our facilities are again engaged in production of peacetime merchandise . . . and we can assure you of reasonably prompt deliveries on over 60 of our fastest-selling pre-war lamps and brackets.

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Watch for an important Faries announcement early in 1946. There'll be many brand new developments in both incandescent and fluorescent desk lamps, clamp-on lamps and floor lamps . . . including special designs for the "circline" and "slimline" fluorescents. A line you'll be proud to sell!

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HAZAKROME—12—T—600 V—SYNTHETIC

FOR WET OR DRY LOCATIONS . . .

HAZAKROME

Building Wire

TYPE T

is designed for ordinary locations in buildings of all types.

TYPE TW

is designed for moist locations in accordance with Section 3035 of the N. E. C.

Insulation and protective sheath are combined in Hazakrome Building Wire. Its plasticized synthetic resin insulation has proved itself in over five years of service to the building trade, providing outstanding advantages in:

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A non-flammable thermoplastic, Hazakrome is oil and chemical-resistant and will not oxidize or sun-check. It has high dielectric and mechanical strength, and its aging qualities insure long life. It contains no fibrous braids or tapes to rot, no saturants to flake off or soften.

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In addition to requiring no braid, Hazakrome Building Wire has a lighter wall of insulation on small sizes than Type R Wire. Thus a greater number or larger sizes of wires can be pulled in old buildings, and new buildings can be adequately wired for heavier copper for future needs without increasing conduit costs.

3. EASY HANDLING

The smooth, hard glossy finish makes Hazakrome easy to pull. It strips clean for splicing and soldering. Thin-wall insulation produces light weight wire that is easy to handle.

4. SIZE and IDENTIFICATION

Hazakrome small diameter Building Wire is available in all standard sizes up to 1,000,000 CM, and in a wide range of colors. It is suitable for an entire wiring system.

Types T and TW, sizes from 14 to 4/0, are approved by Underwriters' Laboratories. Hazard Insulated Wire Works, Division of The Okonite Company, Wilkes-Barre, Pa.

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insulated wires and cables for every electrical use

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In other words, it is equipment that competent people have tried to make of good quality for public use.

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Engineered to provide for greater lamp brilliance, longer lamp life, synchronized starting, hum-free operation, better all around performance and efficiency. Complete range of sizes from 15 to 100 watt; single, two, three or four lamp; and lead, bottom lead or universal lead designs. Write for Catalog 167A.

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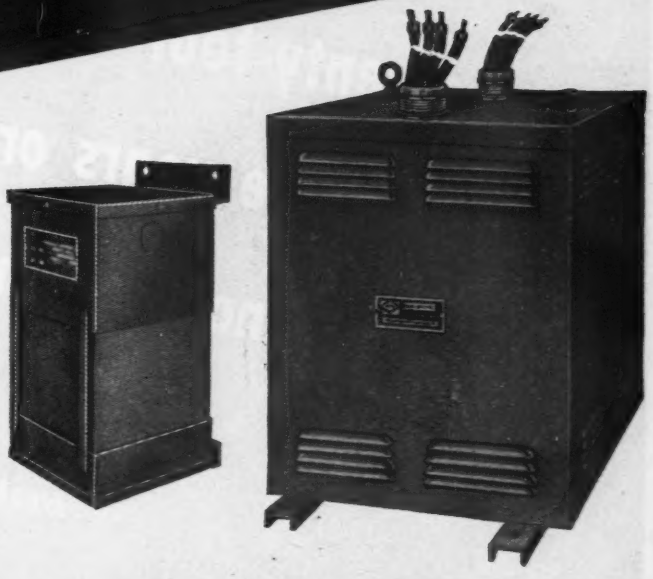

Acme ACME Electric
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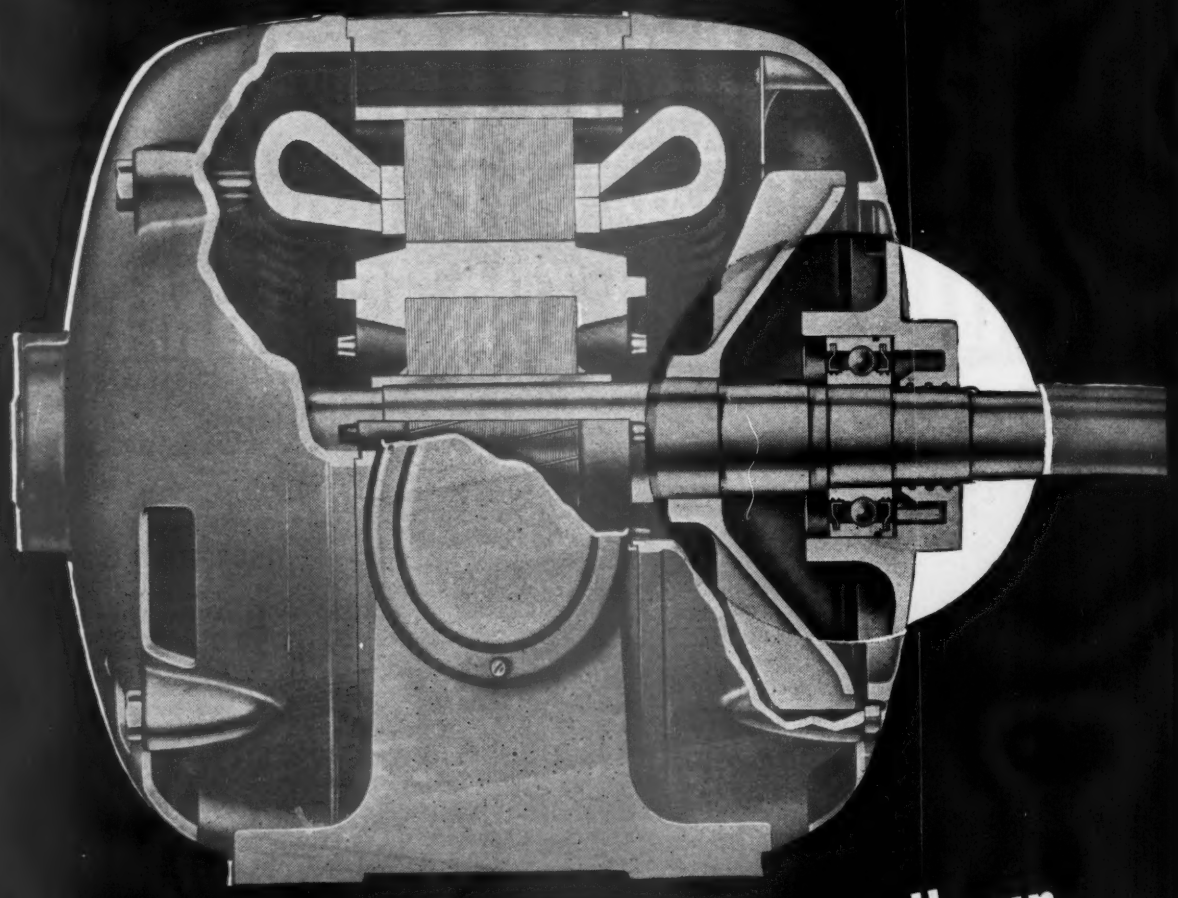
THE ACME ELECTRIC AND MANUFACTURING CO.

GENERAL OFFICES **CUBA, N. Y.**



these Westinghouse motors will run twenty-four hours a day— for five years or more— with no greasing

eliminates frequent bearing lubrication

THE BIGGEST ITEM OF MOTOR MAINTENANCE

Another great step forward in the design of squirrel-cage motors of 15 horsepower and under (frames 326 and smaller) is being offered by Westinghouse. It's the Prelubricated Ball Bearing.

Instead of the periodical lubrication required by the bearings in conventional motors, the lubrication of these bearings can be forgotten for five years or more, even *when operating 24 hours a day.* The saving in time of maintenance crews is obvious, but there are other important advantages, too:

No overgreasing
No "skipped" bearings
No grease contamination
No grease seepage
No unreplaced pipe plugs

All these add up to longer bearing life and smoother motor operation through years of continuous service. For complete information, write for Bulletin B-3554 and Descriptive Bulletins 3100-CSP and 3100-1 to Westinghouse Electric Corporation, P. O. Box, 868, Pittsburgh 30, Pennsylvania. J-21342

TYPE CS MOTOR

TYPE CSP MOTOR

WESTINGHOUSE SPECIAL FEATURES

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- **IMPROVED TUFFERNELL INSULATION.**
- **DYNAMICALLY BALANCED ROTOR.**
- **DIE-CAST ROTOR** with over-size fan.

Westinghouse

PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE

WESTINGHOUSE SQUIRREL-CAGE MOTORS

LABOR *and* MANAGEMENT MEET— *for* PEACE *or* CIVIL WAR?

THE prospect of a knock-down and drag-out fight in the automobile industry does not augur well for the reconversion outlook, which upon every other score is bright. Any widespread outbreak of the type of industrial warfare which now threatens will disrupt, more thoroughly than anything else on the horizon, an orderly transition to a peacetime economy.

It is doubly unfortunate that there should be a general tightening of union and company battle lines upon the eve of the Labor-Management Conference, which on November 5th will convene at President Truman's direction for the purpose of "working out by agreement means to minimize labor disputes." If the current work stoppages occasioned by industrial conflicts should increase rather than diminish between now and November first, the Conference atmosphere hardly promises to be favorable to a dispassionate examination of basic issues.

Yet the shadow of the threatened industrial storm that hangs over the Conference only serves to emphasize the importance of reaching satisfactory agreement upon two problems with which such a Conference might deal. The first is that of determining what machinery shall be used for settling disputes upon which employers and workers have reached an impasse. The second, and more far-reaching, is that of arriving at some common understanding upon the major issues which commonly lead to irreconcilable disputes.

Settlement of Wartime Disputes by the War Labor Board

During the war the first problem was handled largely by machinery centered in the National War Labor Board. Supported by general adherence to patriotic pledges by labor leaders and employers not to resort to the use of economic force against each other during wartime, and backed up on rare occasion by use of the President's power to seize plants for war purposes when its orders were not obeyed, the Board managed, by what amounted to compulsory arbitration, to settle the nation's wartime labor disputes with relatively little economic loss.

But it can scarcely be claimed that the War Labor Board did much to resolve the issues from which disputes grow. Indeed, the fact that it was available to issue orders in cases which the Secretary of Labor certified as likely to "lead to substantial interference with the war effort", resulted in the conversion into full fledged disputes of many disagreements which would otherwise have been settled at a local level in the course of collective bargaining. Meanwhile, local collective bargaining machinery which should have been doing most of this work was neglected, and will need thorough reconditioning even to be brought back to its prewar level of effectiveness.

With V-J Day came an abrupt change in the status of the War Labor Board. One of its main props, labor's "no strike pledge", was promptly withdrawn. It could no longer rely on the President to use his power to seize plants for war purposes to force obedience to its orders. Consequently the Board agreed that it would accept new cases only if both parties to the dispute stipulated in advance that they would abide by the Board's findings, that it would clear its dockets of old cases as rapidly as possible, and that it would then go out of business, leaving to the Labor-Management Conference the question of what should take its place in the postwar period.

What Shall Take the War Labor Board's Place?

The immediate and pressing task of the Labor-Management Conference is to agree upon machinery for settling industrial disputes in the peacetime economy.

Neither management nor labor wants the continuation of compulsory arbitration to which they submitted as a necessary war measure. But it must be clear to everyone that if any substantial proportion of the disputes that inevitably arise are settled by resort to strikes and lockouts, economic anarchy will result. Not only will it be impossible to achieve the high levels of output and employment that have been set as postwar goals, but it is questionable whether our economy could survive. The only alternative to compulsory arbitration under government auspices is for management and labor to demonstrate their ability to effect a peaceable resolution of their differences without it.

The most obvious need is to set up local machinery at the grass roots where disputes originate. That is where most of them should be settled by local negotiation and, when that fails, through voluntary submission to mediation or arbitration under terms of reference to which the parties agree. Many issues, which at plant level are relatively simple in character, are blown up to formidable dimension and complexity when they are passed along

the line for decision in Washington. The centralizing process is one that frightens everyone connected with it because it focuses attention upon the possible importance of precedents established by a decision, rather than upon resolving satisfactorily the particular dispute at hand.

Unquestionably, some Federal machinery must be provided which may be called upon in cases where the size or implications of a threatened dispute clearly run beyond local jurisdiction. That will mean the thorough revamping of conciliation and mediation machinery which exists, but which has grown rusty through disuse while compulsory arbitration was the order of the day.

At least, this involves a complete overhauling of the United States Conciliation Service with a noteworthy strengthening of its personnel. There may be wisdom also in recently advanced suggestions for the creation of a board of arbitration to act in cases voluntarily submitted by the parties concerned, and for boards of inquiry to make reports upon the merits of disputes in which the public interest is concerned. But there is valid ground for questioning what appears to be the common assumption that such machinery should be located in the Department of Labor. It belongs neither there nor in the Department of Commerce. For the work which such agencies are called upon to perform, both the appearance and fact of complete impartiality are essential to effective performance. Assurance of impartiality will not be fostered by placing them in a department specifically charged by Congress with the task of advancing the interests of wage workers.

Resolving the Issues Over Which Disputes Arise

It may be, as many think, that the forthcoming Labor-Management Conference cannot effectively handle any problems beyond the procedural ones suggested above. If that is true, its agenda probably should be restricted to planning the reconstitution of collective-bargaining and dispute-settlement machinery, in view of the urgent need for putting it in working order.

But either in this Conference, or in subsequent ones, there will have to be an attempt to reach a reasonable measure of labor-management accord upon certain basic issues over which most industrial disputes originate. The best of machinery can be swamped if disputes are generated in ever-increasing number.

Most important of such issues is that of the fair determination of wages. There is clear need for reaching agreements at least upon the major factors on which such determination should rest. It seems evident that if we are ever to hope to reach the high levels set and generally accepted as postwar goals, we must harness economic incentives to promote production efficiency. That means that workers, as well as management, must be given a genuine stake in increased productivity. No universal formula is possible, but we should be able to agree upon general principles for dividing returns derived from improved performance in output between workers and investors, and consumers in the form of lowered prices.

Again, since unionism is here to stay, general acceptance by management of the principle of collective bargaining would save innumerable disputes which are concerned more with the method of negotiation than with the concession sought. Few in management still question the validity of the collective bargaining process as such, but there are many matters to be resolved of which the question of the open shop, the union shop, or the closed shop is merely a conspicuous example, upon which there is wide divergence of conviction between and within labor and management groups.

On the management side, there is sincere concern about the intent or ability of union leaders to exercise responsible control that assures compliance with contractural obligations. Wild-cat strikes are of sufficiently frequent occurrence to give substance to this distrust, and union discipline seldom has been administered in a decisive or effective fashion. The prospective rivalry of three competing labor organizations of national scope gives management little confidence that a bargain made and kept in good faith with any one of them provides assurance against work stoppages.

All of these matters, and many others, need thrashing out between management and labor, with the view of arriving at as large a measure of specific and detailed agreement as can be achieved. The greater the area of such agreement, the smaller will be the area for disputes that must be handled by settlement machinery, or put to the final test of force.

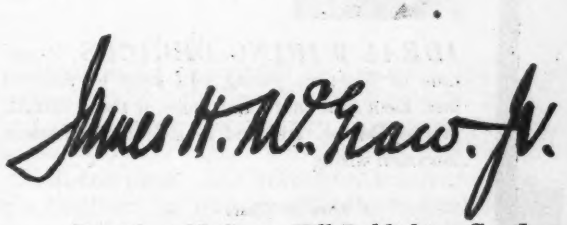
Peace or Civil War in Industry

The Labor-Management Conference is of major importance to national welfare. It is important even if it restricts its objectives to the procedural problem of how industrial disputes are to be handled.

It can make an even larger contribution if it lays the groundwork for an attempt to reach working agreements upon such policy issues as have been cited above.

Neither management nor labor can afford to lend anything less than their best intelligence and effort to an attempt to arrive at common understanding. Success will mean that we have a genuine chance of reaching new levels of economic well-being. Failure will mean industrial civil war, in which the casualties will be high. One almost certain casualty of such a war will be the principle of collective bargaining, since the Government can scarcely refrain from establishing compulsory arbitration if sufficient breakdown occurs.

It is to the vital interest of both management and labor to demonstrate that they can responsibly control themselves.



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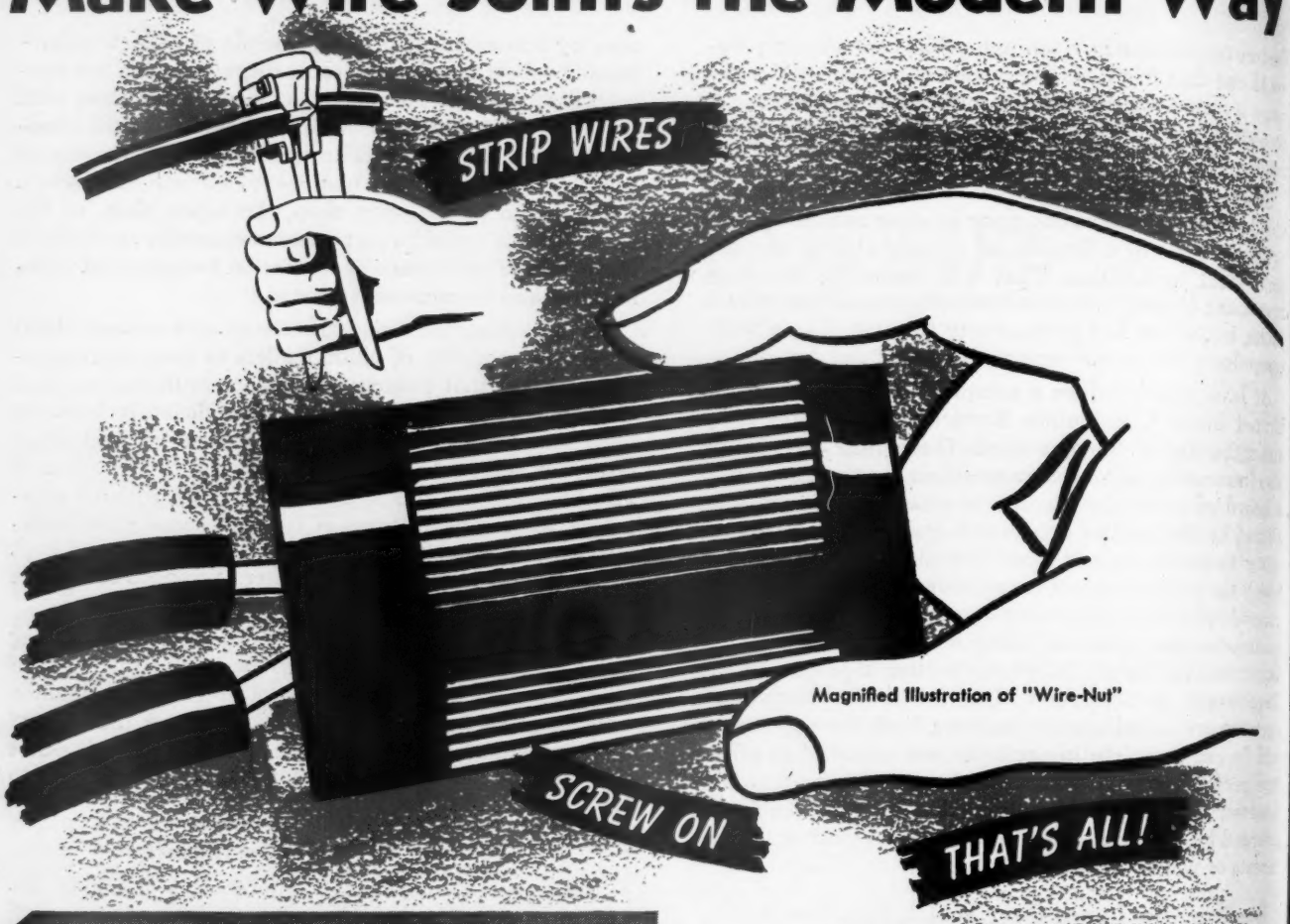

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- Wire Strippers
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A size for every job! Ideal "Wire-Nuts" are the modern wire connectors used in wiring — new circuits, rewiring, plant changes, relocating machinery, etc. You can make all wire joints without solder or tape — all you need is a pocketfull of IDEAL "Wire-Nuts."

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OCTOBER . . . . at a Glance

Pretty much submerged under the dramatic story of the atomic bomb, another great military development was cut loose from censorship at the same time—the story of radar and its great contribution to victory. Radar promises to play a great role in peace time as well, and now that secrecy has been lifted, we can expect many new applications of the methods which have been learned to the industrial and commercial life of the nation. You will find the basic principles of how it works in the article, "Radar" on page 83.

★

Every year we devote a goodly amount of our October issue to the subject of lighting, usually by way of a comprehensive analysis of one phase or another of this tremendously important field. The special editorial feature section which appears in this issue on the subject of PLANNED LIGHTING is one of the most ambitious editorial projects we have ever tackled. We sought the cooperation of eight leading illumination engineers and they have presented, in comprehensive case studies, as many PLANNED LIGHTING schemes that are up to the minute in the techniques and methods employed. With lighting representing one of the greatest markets of all time, be sure that this material is routed to everyone in your organization concerned with either sales or engineering. This special section begins on page 97.

★

Acting promptly on the relaxation of ODT regulations, the National Electrical Contractors Association has called a meeting for October 29-31, at the Hotel Carter in Cleveland, Ohio. It is NECA's first postwar meeting and it comes at the time when there are great problems before the industry. It should attract a record attendance.

★

With L-41 off the books as of October 15th, and construction getting the green light all over the country, it is time to give close attention to estimating practices and procedures. Beginning in this issue is a series of thoroughly up to date, comprehensive articles on estimating, which will provide a sound and useful guide for the days ahead. "How Much Will It Cost?" begins on page 86. Ray Ashley, Research Engineer of the Electrical Contractors Association of the City of Chicago is the author. He is well known as an outstanding authority in this difficult and important field. His timely series is worth close study. It is well supported by accurate cost sheets geared to the times.

★

Three Buffalo electrical contractors devoted their organization and skills to the three million dollar electrical work contract at Curtiss-Wright. The wiring system is a particularly interesting example of high voltage distribution, which serves lighting and four types of power circuits, including high cycle and direct current. The well-illustrated story of this great project appears on page 90.

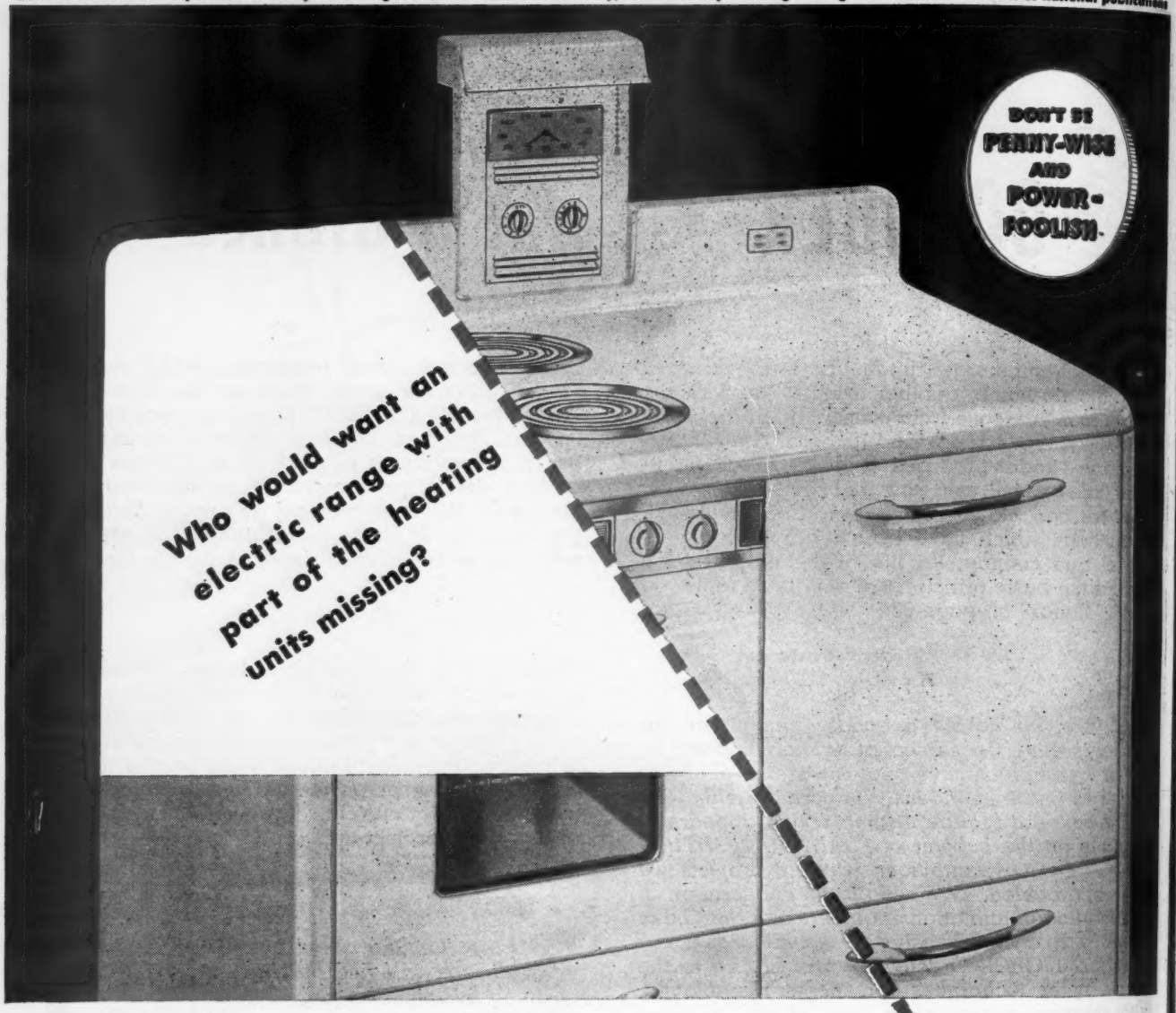
★

If you are thinking about going into business for yourself, you will find Bill Ritt's story on the cost of doing business, on page 94, one of the most important documents you ever read in your life. The figures and analyses which he has given in this article are based upon actual successful contractor dealer operations. His experience with a great many firms in the North-Central area have given him a particularly wide range of experience with just the kind of judgments that determine whether a business will make the grade or land in the hands of the sheriff. How much capital will you need? How much credit? How much money can you expect to make? All of these are answered in frank and factual terms.

★

Uses of flammable chemicals in industry and the tremendous job of handling liquid petroleum products has given new importance to measures for preventing spark ignition from static electricity. Static produces numerous industrial hazards. The methods outlined in this month's Industrial Electrification section, page 161, is must reading for all electrical men concerned with industrial problems.

Because of the basic importance of adequate wiring to the entire electrical industry, Anaconda is presenting messages like this in a wide list of national publications



—Yet skimpy electrical wiring can just as seriously cut appliance performance!

plan with foresight... Wire ahead

—and not just for your new electric range—but for refrigerator, dishwasher, garbage disposer, exhaust fan—your host of new appliances—perhaps advanced heating and lighting. All may be power-starved by inadequate, out-of-date wiring—their efficiency reduced *25% to 50%*.

Obviously you'll want to avoid such waste and inconvenience. Then make sure wiring capacity will match increased electrical usage. *Now* is the time to check your plans. Avoid costly alterations later.

Business Executives! This also applies to *your* postwar wiring. You don't want expensive future adjustments either — embarrassing shutdowns to bring wiring capacity up to increased production needs. Today—see your consulting or plant power engineer, electrical contractor or power salesman. They'll advise: Wire Ahead! Anaconda Wire & Cable Company, Subsidiary of Anaconda Copper Mining Company. General Offices: 25 Broadway, New York City 4. Chicago Office: 20 North Wacker Drive 6. Sales Offices in Principal Cities.

✓ Check your wiring plans before they check you!

ANACONDA **ANACONDA WIRE & CABLE COMPANY**

SETTING THE PACE

NECA renews its annual meetings by holding sessions in Cleveland this month. As NECA's first postwar convention, it promises to be a meeting of outstanding interest to its members and equally important to the industry as a whole. For—and I want this to be most emphatic—*the policies set forth by electrical contractor organizations and the follow-through by individual firms in the coming months and years will set the pace for the entire electrical industry.*

And that's responsibility. It isn't a particularly comfortable outlook. It offers no grounds for self-congratulations. The force of technological progress in electrification, the cumulative demands of industry, commerce and modern living for new and better ways of doing things has thrust it upon us. And from everybody from the gent in the plush skyscraper office to the guy with a shingle on his front porch, it will demand more imagination, initiative and enterprise than he ever had to exert before.

The plain fact is there isn't one segment of the electrical industry that can forge ahead without the cooperation of the contractor. But—more important—there isn't one segment of the electrical industry that can avoid forging ahead if the contractor assumes the full responsibility and leadership that is open to him today.

Have not industry leaders been emphasizing this for many years? Are not our intra-industry relationships pretty much the same as before? Emphatically no! We are facing markets and prospects of an entirely new order of magnitude and of much greater technical complexity. And here's why. There are two future developments which can be impeded only by a major economic disaster:

1) A building boom, far exceeding that of the 1922-1928 period, which will unquestionably follow functional lines, bringing much greater emphasis on the mechanical trades, and particularly on electrical work.

2) A tremendous upswing in electrical development, spearheaded by new utilization and control devices and apparatus, all of which require wiring and most of which require expert installation and skillful maintenance.

With such prospects, there is going to be some temptation to sit back and enjoy it; to chase new brick-piles, to follow anybody's plans and specifications uncritically, to narrow sales efforts to price bidding, and to devote know-how and engineering talents exclusively to nut and bolt problems on the job. But there is enough enlightened self-interest in the industry today to recognize that minimum service brings minimum reward. And there is enough imagination and initiative to accept our responsibility to the industry and the public to perform our job to the best of our ability.

NECA faces the job of inspiring a courageous and confident approach to the task ahead; of providing leadership, services, coordination and enthusiasm to the greatest opportunity in its history. But leaders can only set the pace. The real responsibility rests with every man who has cast his lot with the industry. Whether its destiny is great or mean is squarely up to him.

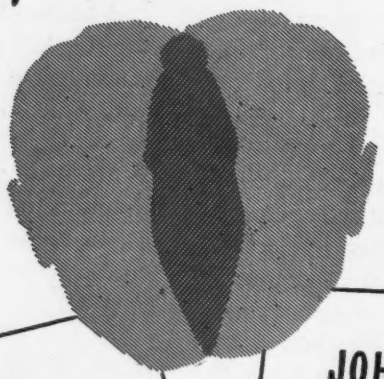
Wm. T. Stuart

HELPING CONTRACTORS MAKE CONNECTIONS

Graybar believes that the electrical contractor has a mighty important part to play in the swift revival of commercial building. Everyone is enthusiastic about the possibilities for modern electrification, but it's the contractor who'll have the responsibility of accomplishing them. That's why, through advertisements like this in *The Architectural Forum*, Graybar is encouraging architects and builders to work with you earlier, when your experience and advice counts the most. 4582

PUT THESE HEADS TOGETHER EARLY

and your project won't be late!



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OR YOUR ELECTRICAL ENGINEER

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YOU know the electrical features that your client ought to have to make his building truly modern.

"JOHN WATTS" (any qualified electrical contractor) knows the newest electrical devices and wiring techniques. In addition, he's up-to-the-minute on the installation problems involved—problems of meeting local codes and ordinances, of labor conditions, of product availability, and the effects of innovations on installation costs.

By checking with "John Watts" early in the stages of design, you make certain that the electrical side of your plans will be fully practicable under prevailing conditions. There's no more important factor in getting projects completed on time.

Yes, "John Watts" offers you valuable help on plans for wiring, lighting, signaling, and electrically driven apparatus — for industrial, commercial, or residential building.

You get the newest and best in everything electrical when you work with "John Watts", because well-informed contractors everywhere get their electric supplies and tools via Graybar. Graybar Electric Company, Graybar Building, New York 17, N. Y.

4581

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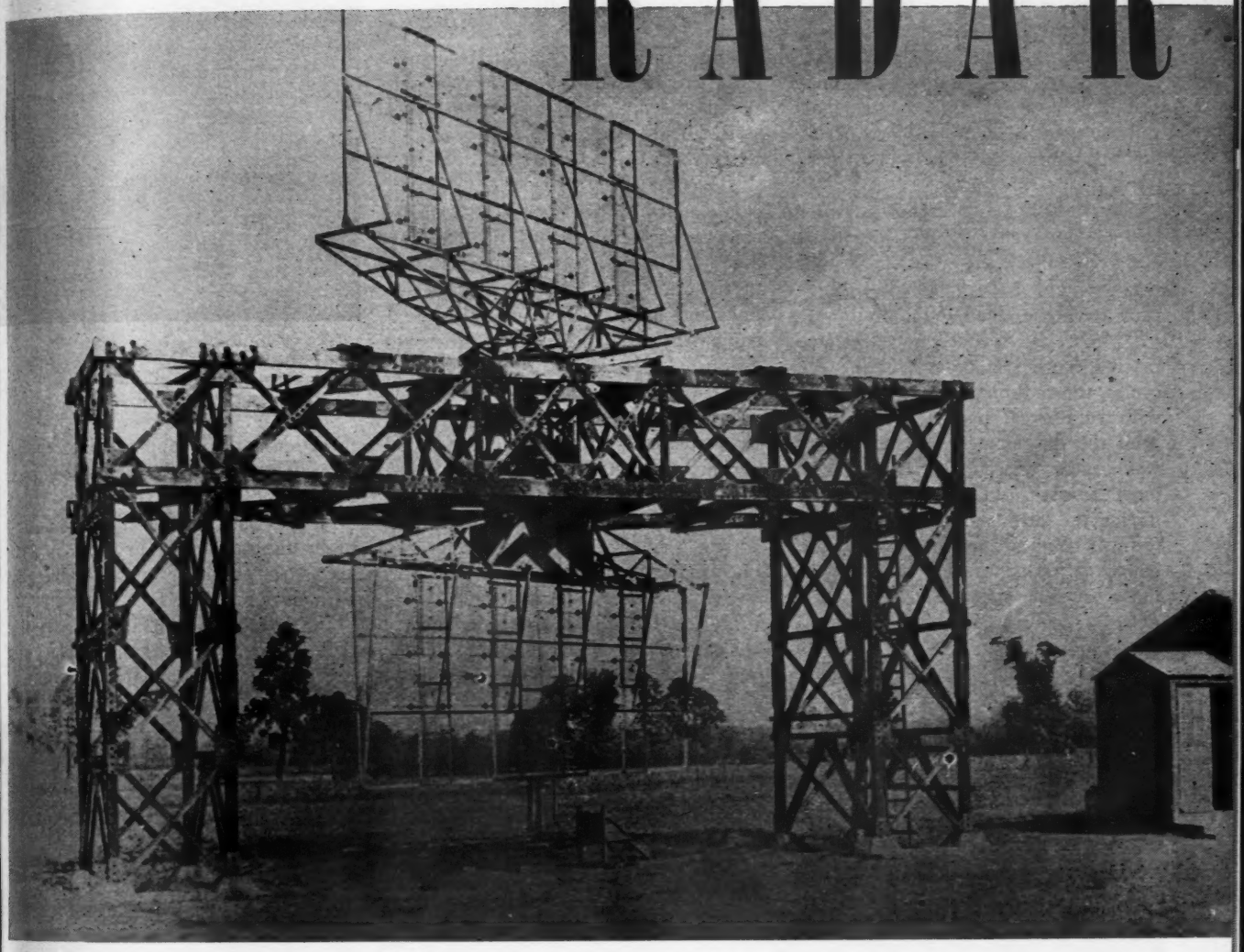
THE ARCHITECTURAL FORUM, OCTOBER, 1945.

RADAR

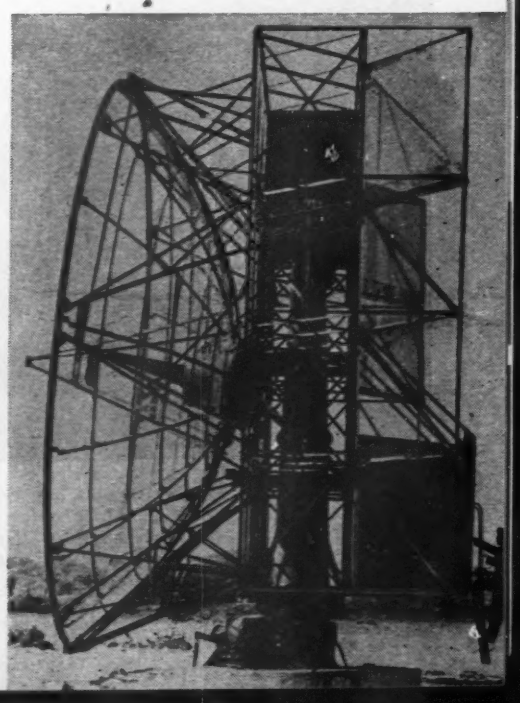


Broadside arrays of dipoles and reflectors in rotating mount forms typical antenna system for ground controlled interception radar, equipment specially designed for the control of fighters intercepting enemy aircraft.

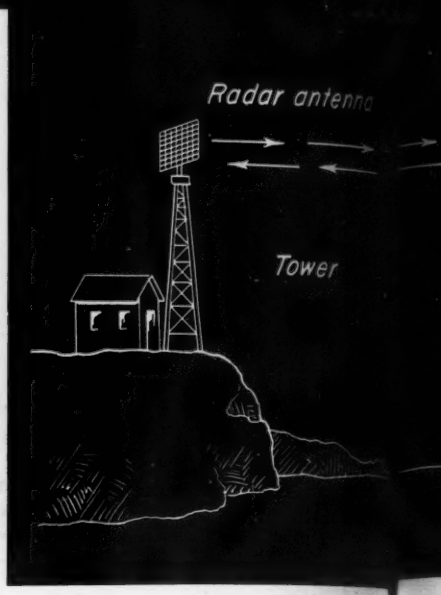
New radio technique opens new areas for application of high frequency energy.

RADAR, radio direction and ranging, was removed from the cloak of censorship when Japan surrendered. It gave to defense and offense a mighty new weapon in World War II. It will play an important part in peace. In this brief article, we shall outline some of the highspots of this significant development in the electrical field.

Radar is the generic term for a family of radio techniques based upon the use of the radio echo. Just as a sound wave echo from a distant cliff can be timed to find the distance, radio pulses are shot out and their echoes timed to measure the range of distant objects. If the pulses are swept or "scanned" over an area and the echoes assembled and displayed on a synchronized cathode ray oscilloscope, a picture or map is drawn.



Paraboloid type of radar antenna provides sharp "searchlight" beam of energy. In microwave radar using centimeter wavelengths parabolic type reflectors are much smaller and more accurate.



Although the principles of radio reflection have been known for decades, the rapid development of radio techniques in the ultra high frequencies opened the way for the extraordinary precision in modern radar. Gun directing radar is, for example, more precise than any gun that can be made and navigation radar is more precise than the maps and charts used in operations.

Any radio waves can be accurately beamed and reflected. Dimensions of aerial equipment, however, do not become practical until the frequencies used are higher than 100 million cycles (100 m/c) per second. As frequencies reach the order of thousands of megacycles, the radio beams can be handled with very great precision and it has been the development of such microwave radar which has created the almost fantastic radar equipment in use during the latter months of the war.

In its simplest form, radar apparatus employs a transmitter arranged to send out very accurately timed bursts or pulses of energy. In the intervals between pulses an extremely sensitive receiver is connected to the antenna array. The transmitted signal produces a V shaped break in a thin line sweeping across a cathode ray oscilloscope. This break is adjusted to an index line. Any reflection received from a ship or aircraft appears as a smaller V shaped break in the line. The distance from the index line to the echo "pip" is scaled in distance. Thus the range is read instantly and accurately.

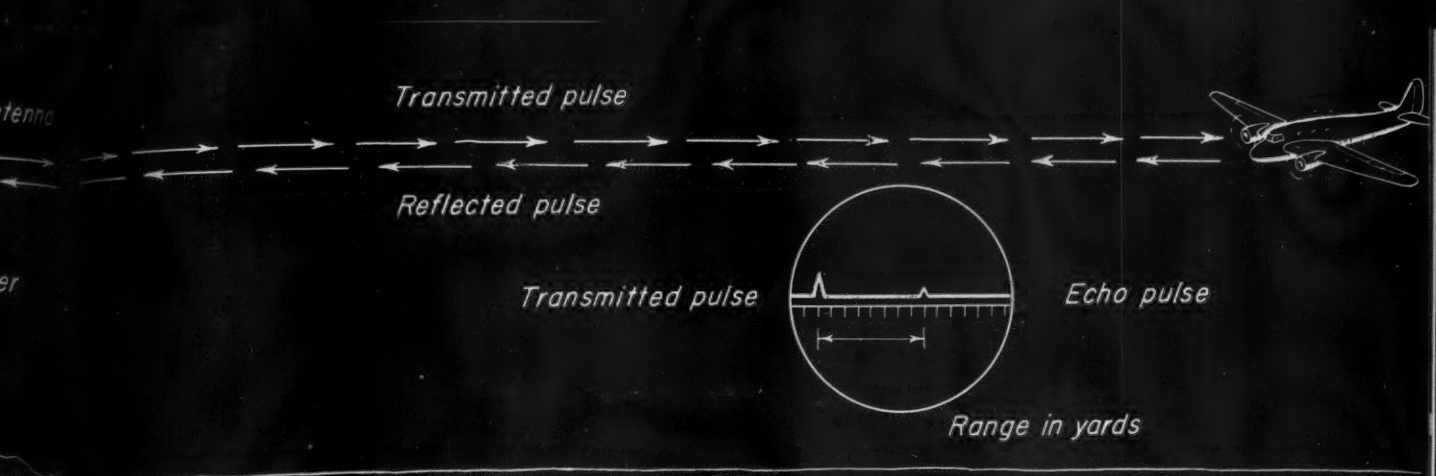
Since the pulses are beamed by elaborate antenna arrays, the beam can be scanned or swept across the horizon. The point at which the reflected signal is strongest gives the direction. Refinements in this basic method in actual equipment provide for very great precision.

Most spectacular is the so-called PPI (plan position indicator) display. Here the antenna is rotated and the scope synchronized in a radial pattern. Shore lines, ships and planes appear as on a map or chart of the surrounding area.

The electrical signals which produce indications on the scope can also be fed into fully automatic gun directors. Thus, for the first time in history, we have a gun which literally aims itself. The radar, pointed in the general direction of an approaching enemy aircraft sweeps the area. As soon as a reflection is received, the radar "freezes" onto it accurately and unerringly, feeds all necessary data into an automatic predictor and aims the gun with uncanny precision.

Bordering on the fantastic is the radar control center. Radar displays are projected onto a translucent screen

Radar signals are "displayed" on the fluorescent screen of the cathode ray oscilloscope. Most radar requires skillful interpretation by highly trained operators. Several types of display can be used to show range, direction, height or signals can be assembled into a plan "picture." New tubes can project large patterns on a translucent screen.



Typical ranging with radar. Timed pulses from radar station are reflected by plane. Difference in time between outgoing pulse and reflected echo is displayed on cathode ray oscilloscope. Index scale shows time difference expressed in distance. Radar pulses travel 300,000,000 meters per second.

together with optical projection of maps, battle plans and plot sketches. Thus the commander can sit in a room at headquarters or in a control center deep inside a battleship and watch all the movements of clearly identified hostile and friendly craft displayed before him on a map.

The apparatus of radar is built around new types of electronic tubes capable of oscillating at extremely high frequencies. Two of the most common types are the "klystron" and the "magnetron" which are self contained generators of high frequency energy. The high power output in short pulses is carried through special transmission lines to antenna arrays. Returning radio echoes are picked up by extremely sensitive receivers, amplified and "displayed" on the oscilloscope.

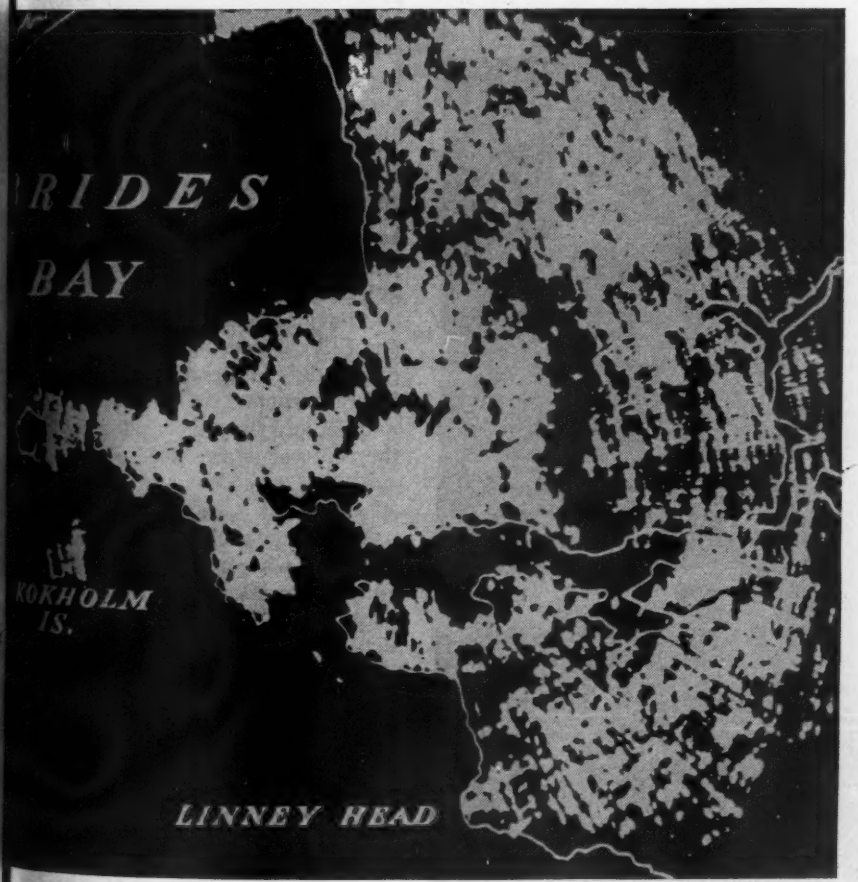
Transmission lines for microwave radar are radically different from conventional power circuit wiring. The spacing of two or four wire lines is critically important and insulation presents new problems. Coaxial lines, one conductor within another, are frequently employed. Supports are often resonant loops which are simple U shaped metal members grounded at the center. If the sides measure a quarter wave length, they offer a high impedance to the line and consequently may be used as insulators.

A great many such resonant loops could be placed along a two wire line both above and below forming a rectangular pipe. This is the basis for the wave guide which is simply an empty tube capable of conducting large quantities of high frequency energy. The wave guide is used only in radar systems operating at extremely high frequencies, in the order of thousands of megacycles, since at lower frequencies guides are impractically large.

Antenna systems vary from great arrays of dipoles, reflectors and directors to small "headlights". Structures range from great coastal towers to small rigs which fit easily into the wings of a plane.

The developments in wartime radar will be carried directly into peacetime operation in several fields. Aircraft navigation and landing devices and blind flying equipment are immediately adaptable for commercial and private aviation. Radar at sea makes pin-point navigation simple "dial watching".

Cost of radar apparatus today precludes its application to private automobiles and small boats. However, there are apparently no fundamental obstacles in the way of low cost apparatus development.



Radar "map", PPI type is produced by scanning the area. Synchronized scope reproduces reflections from objects and land masses in an accurate picture. This is the southwest tip of Wales as photographed from the glowing green pattern on the scope. Newer equipment gives much more accurate detail.

How Much Will It Cost

? PART I

PRELIMINARY estimates for electrical work are important and justify more consideration than they ordinarily receive. Contractors who are asked to supply them should decline if they are not willing to jump in with both feet and do the work properly. Those who carelessly prepare such estimates jeopardize their own business connections, place buyers' representatives in embarrassing positions, and, in general, are a detriment to the industry. On the other hand, contractors who properly prepare preliminary estimates are strengthening their connections with clients by providing a useful, reliable service and benefit the industry by forestalling the many difficulties resulting from unreliable cost figures. By being accurate they are helping to establish a substantial price level which the public is willing to accept.

Lack of proper, complete information, is the usual alibi offered by contractors who are lax in their estimating practices. Those contractors are definitely at fault. As long as contractors are willing to "stick their necks out" by guessing at indefinite specification clauses or plans, architects, engineers, and owners probably will do nothing to discourage such foolish practices. Cautious contractors insist on having all details as a sound basis for their estimates.

If a contractor is in a position where he cannot feel free to ask for—and get — complete data, there is little to be gained by his preparing a price. If he gets little consideration while preparing the estimate, it is unlikely that he will get any sincere consideration after the contract is awarded.

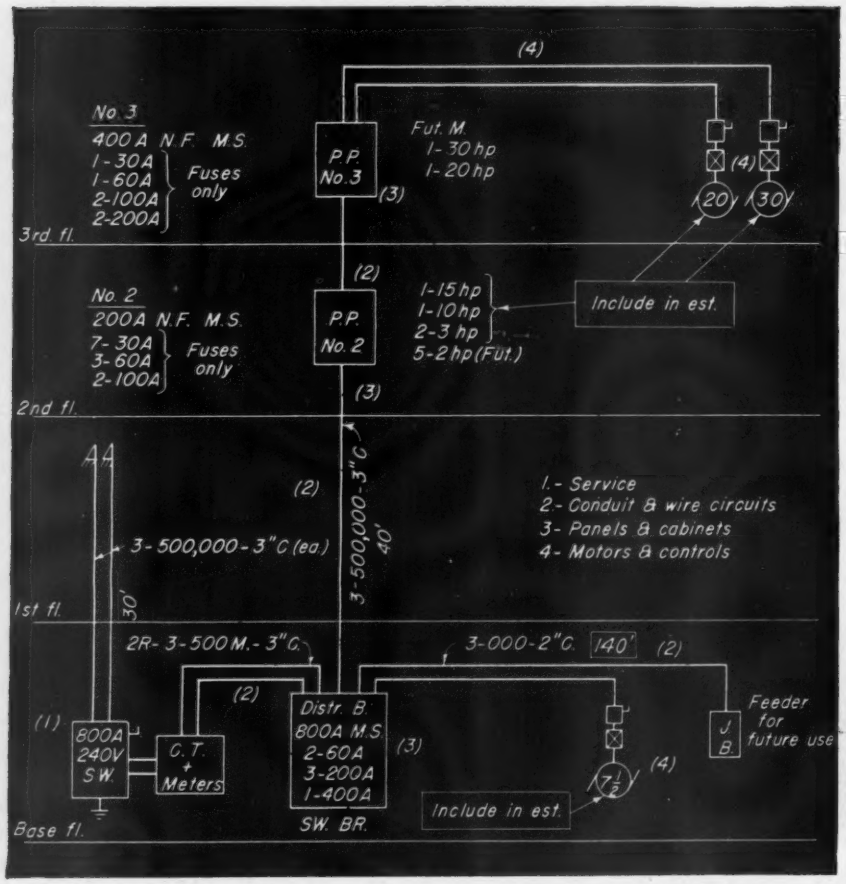


FIG. 1—Logical division of a power system for the purpose of "unit costing." 1—Services; 2—Conduit and Wire Circuits; 3—Panels and Cabinets; 4—Motors and Controls.

It's A Selling Job

Those who are prone to "guess" when preparing preliminary estimates, because of "insufficient information," may experience difficulty convincing their clients of the value of sound preliminary figures. Such clients, having been accustomed to receiving "guestimates," will be slow to appreciate the necessity of supplying complete data when asking for cost figures. It is difficult for them to understand that electrical work is pretty much a custom-built job and cannot be quoted on a lineal-foot or square-foot basis like many items of building construction.

The contractor has a selling job on his hands. He must convince the own-

Preliminary estimates form the basis of construction budgets. Too often they are haphazardly prepared. This first of five articles will analyze the need for accuracy. Succeeding articles will present cost sheets as a guide for quick field preparation.

By Ray Ashley
Research Engineer
Electrical Contractors
Association of City of Chicago

er's representative that full information is needed to prepare accurate cost figures; that much wasted time, energy and unpleasantness can be avoided if such data is given to the contractor when he is asked to make a "preliminary"; that the electrical system is an integral part of a building—just as important from the functional standpoint as the structural design; that many advantages can be gained by thinking of and designing the electrical system early in the planning stage of the building program.

It is a general conclusion that the electrical system is usually one of the last things considered when a building is planned. Were it one of the first, the whole complexion of the electrical construction program would be changed. It would hold a higher priority in the owner's mind and receive more consideration all along the way.

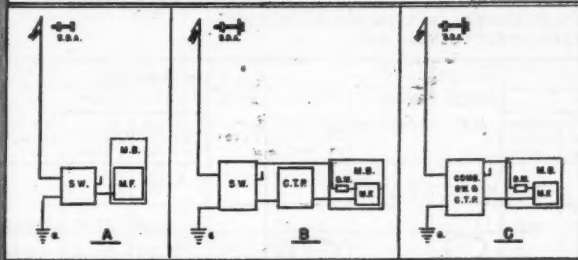
Need for Early Planning

Being one of the last things considered, there is a tendency for the owner to regard electrical work as a more or less "nuisance part" of the building and to grudgingly provide proper allowances for installation. Being initiated late in the program, electrical plans and specifications are prone to be rushed and emerge in a somewhat incomplete form. Not until actual installation is started does the owner begin to seriously consider his electrical requirements. Usually, additions must be made. That means "extras" and all the inherent friction that accompanies such conditions. It is a known fact that there is as much argument over a few dollars worth of electrical work as there is over a few hundred dollars worth of building construction.

FOR PRELIM. FIELD ESTIMATING

UNIT COSTS FOR 3PHASE 3WIRE SERVICES

LABOR RATE 1.70 PER HOUR



S.D.A — SERVICE-DROP ANCHOR
S.W. — SERVICE SWITCH
M.F. — METER FITTING
C.T.R — CURRENT TRANSFORMER PANEL
D.M. — DEMAND METER FTG.
COMB. SW. & C.T.R - COMBINATION SERVICE SWITCH & CURRENT TRANS. PANEL.
M.B. — METER BOARD
G. — GROUND CONN.

250 VOLTS									480 VOLTS					
TYPE	COSTS-DIRECT MATERIAL	LABOR DIRECT LABOR	LABOR INS.&DIR. JOB COSTS	SELL PRICE ESTIMATED IN DOLLARS ①	CONTR'S. ADJUSTED PRICE	SWITCH SIZE IN AMPS.	WIRE SIZE	CONDT. SIZE INCHES	TYPE	CONTR'S. ADJUSTED PRICE	COSTS-DIRECT MATERIAL	LABOR DIRECT LABOR	LABOR INS.&DIR. JOB COSTS	SELL PRICE ESTIMATED IN DOLLARS
A	16.00	17.80	3.55	44.50		30	8	3/4	A		26.00	18.30	3.65	56.00
A	33.50	27.20	5.45	78.00		60	6	1 1/4	A		35.00	28.50	5.70	82.00
A	35.00	27.60	5.50	80.00		60	4	1 1/4	A		37.00	29.00	5.80	84.50
A	44.00	30.00	6.00	93.75		100	4	1 1/4	A		51.00	31.00	6.20	102.50
A	47.50	35.70	7.15	106.50		100	2	1 1/2	A		55.00	36.75	7.35	116.00
A	53.00	36.55	7.30	113.50		100	1	1 1/2	A		60.50	38.00	7.60	124.00
A	76.50	46.00	9.20	156.00		200	0	2	A		89.00	46.50	9.30	168.00
A	82.00	48.00	9.60	163.00		200	00	2	A		96.50	50.50	10.10	182.50
A	88.00	50.00	10.00	172.00		200	000	2	A		102.00	53.50	10.70	193.00
B	146.00	75.75	15.15	275.00		200	0000	2 1/2	B		175.00	78.00	15.60	311.00
B	190.00	81.00	16.20	331.00		400	0000	2 1/2	B		324.00	84.00	16.80	374.00
B	201.00	85.00	17.00	350.00		400	250 M	2 1/2	B		236.00	88.00	17.60	393.00
B	224.00	92.00	18.40	386.00		400	350 M	3	B		258.00	96.50	19.30	430.00
B	232.00	95.50	19.10	400.00		400	400 M	3	B		266.00	100.00	20.00	444.00
B	250.00	97.00	19.40	422.00		400	500 M	3	B		283.00	102.00	20.40	466.00
B	323.00	114.00	22.80	528.00		600	600 M	3 1/2	B		383.00	117.00	23.40	598.00
B	338.00	116.00	23.20	545.00		600	700 M	3 1/2	B		399.00	121.00	24.20	622.00
B	362.00	125.00	25.00	587.00		600	800 M	4	B		422.00	132.00	26.40	664.00
B	379.00	130.00	26.00	614.00		600	900 M	4	B		439.00	136.00	27.20	689.00
B	530.00	163.00	32.60	830.00		800	2 SETS 500 M	2 CONDTS. 3						
B	730.00	240.00	48.00	1168.00		1200	3 SETS 500 M	3 CONDTS. 3						
C	462.00	153.00	30.60	740.00		800	2 SETS 500 M	2 CONDTS. 3						
C	681.00	228.00	45.60	1094.00		1200	3 SETS 500 M	3 CONDTS. 3						

①-INCLUDES MTG. FRAMES AND FUSES.

MARKUPS {MATERIAL—10% ADDED FOR OPERATING COSTS AND RETURN
LABOR—15% ADDED FOR OH. AND 10% FOR RETURN

ELECTRICAL CONTRACTORS' ASS'N. OF CITY OF CHICAGO

FIG. 2—Typical cost sheet for 3-phase, 3-wire services.

A contractor is well aware of the grief that "extras" cause—as are architects and engineers. A contractor who is requested to prepare a preliminary estimate has a chance to start things moving in the right direction. He can, with the architect and engineer, impress upon the owner the importance of the electrical system in the operation of the building he plans to construct; the necessity—and wisdom—of deciding his requirements at an early stage in the planning so the architect will be able to make adequate provisions for them and prepare complete plans and specifications.

Working with architects and owners while preparing preliminary figures provides an opportunity to establish close and friendly relations. The contractor who handles his work properly will create a desire for his services. The owners and architects will feel that he is working *with* and not merely for them. By the time the contract is ready to be let, they will appreciate the advantages and wisdom of selecting a contractor who is sincerely interested in their problems as well as the job.

Effects of Unsound Costs

Let us investigate the ill effects of an unreliable estimate. Despite the fact that an estimate may be too low, it establishes a price figure in the mind

MEDIUM SPEED MOTORS A.C. 3 PHASE

MOTOR DATA & INSTALLATION COSTS

COSTS INCLUDE WIRING (MAT. & LAB.) FROM DIST. PAN. TO MOTOR BASED ON 50 FT. CONDUIT RUN

FOR PRELIM. FIELD ESTIMATING

DATA					MOTOR SIZE	COSTS (PER MOTOR)					
WIRING DATA						CONTRS.	TOTAL	NOTE	DIVISION		
CONDT. (CODE SIZE)	WIRE (CODE SIZE)	MOT. SW. (FUSED) AMP. RTG.	START'G FUSE AMPS.	RUNNING LOAD AMPS.	H.P.	ADJ. PRICE	EST. COST (MARKUP INCL. SEE NOTE) →	(MARKUP USED)	LABOR SET MOTOR	LABOR WIRING & CONN.	MATERIAL
220 VOLT MOTORS											
1/2"	14	30	1 2 3 10 20 30	1 2 3 3 6 9	1TO3		55.00		9.00	27.80	18.20
1/2	12	60	40	15	5		69.50		15.00	31.00	23.50
3/4	10	60	60	22	7 1/2		79.50		19.00	35.00	25.50
3/4	8	100	70	28	10		105.50		23.00	42.50	40.00
1 1/4	6	100	80	40	15		138.00		36.00	53.00	49.00
1 1/4	4	200	110	52	20		162.00		39.00	59.00	64.00
1 1/2	2	200	150	65	25		185.00		45.50	66.00	73.50
1 1/2	1	200	175	77	30		206.00		53.00	73.00	80.00
2	00	400	225	102	40		281.00		56.00	88.00	137.00
2	000	400	250	128	50		324.00		70.00	101.00	153.00
2 1/2	0000	400	300	150	60		384.00		91.00	118.00	175.00
2 1/2	250 M	400	400	190	75		427.00		118.00	122.00	187.00
3	400 M	600	500	250	100		589.00		154.00	158.00	277.00
440 VOLT MOTORS											
1/2	14	30	1 2 3 10 15 15	1 2 3 2 3 5	1TO3		61.75		9.00	28.00	24.75
1/2	14	30	20	7.5	5		71.00		15.00	31.00	25.00
1/2	14	30	30	11	7 1/2		75.00		19.00	31.00	25.00
1/2	12	60	35	14	10		88.50		23.00	36.50	29.00
3/4	8	60	50	20	15		113.00		36.00	41.00	36.00
3/4	8	100	65	26	20		134.00		39.00	47.00	48.00
1 1/4	6	100	70	32	25		160.00		45.50	58.00	56.50
1 1/4	4	100	80	39	30		175.00		53.00	62.50	59.50
1 1/4	4	200	110	51	40		208.00		56.00	70.00	82.00
1 1/2	2	200	125	63	50		247.00		70.00	86.00	91.00
1 1/2	1	200	150	75	60		285.00		91.00	94.00	100.00
2	0	200	200	90	75		338.00		118.00	106.00	114.00
2	000	400	250	123	100		468.00		154.00	130.00	184.00
2 1/2	0000	400	325	155	125		520.00		168.60	147.00	205.00
2 1/2	250 M	400	375	180	150		571.00		182.00	170.00	219.00
3	400 M	600	500	240	200		767.00		204.00	233.00	330.00

MATERIAL PRICED AT MARKET COST PLUS 10% FOR SERVICE CHARGE
LABOR PRICED AT $1.10 PER HR. +20% (INS. & JOB COSTS) +15% (GEN. OH.) +10% FOR RETURN

NOTE—
FOR PRELIM. EST. WHEN EXACT LOCATION OF MOTORS IS NOT GIVEN, EST. AS FOLLOWS:—
(1) ESTABLISH SERVICE & DIST. COSTS BY USING UNIT COSTS PER FT. FOR CONDT. & WIRE AND ADDING COST OF DIST. & PR. CENTER CTS.
(2) FOR BR. WIRING (PR. CENTER TO MOTOR) & MOTOR INSTALLATION, USE —$50.00 FOR EA. MOTOR PLUS $8.00 PER H.P. CONN. LOAD.

R.W.A. ELECTRICAL CONTRACTORS' ASS'N. OF CITY OF CHICAGO 1-15-45

FIG. 3—Typical cost sheet for motor and control installations.

of the buyer—one to which he doggedly adheres in the face of all argument. The owner assumes—and logically so—that the contractor knew what he was doing and that his figures are fairly reliable. So the construction budget is completed using the contractor's figures for the electrical work. When the bids on the final plans and specifications are opened, the electrical work glaringly runs over the budget figure. Then the paring really begins—on the electrical system. Pressure is exerted to secure electrical bids within the original allowance.

Later, it is discovered that the paring was much too drastic. "Extras" begin to crop up and subsequent arguments and ill feeling reach a high pitch. Contracts completed under such handicaps rarely give the owner the type of installation he should have had. Business relations between all concerned are strained almost to the breaking point.

The alternative—and lesser of the two evils—is to have the approximate figure a little high. Unless one is careful, he is apt to submit a low figure despite his efforts to establish a substantial price.

Submitting a price that is *too high* is also undesirable and, when done consistently creates the following reactions:

1. Architects and engineers lose confidence in the bidder.

2. Buyers develop the pernicious habit of discounting bids.

3. Plans and specifications may be "skimped" to an unnecessary degree.

Owners' representatives should be constantly warned of the ills of "by guess and by gosh" estimating frequently practiced in the rush of preparing a figure on incomplete plans and specification data. Contractors should also stress the wisdom of making definite decisions on electrical problems early in the program and the total elimination of last-minute details "hanging in the air."

Preparation for Field Estimating

There is a limit to the accuracy of preliminary estimates; also to the time that can justifiably be spent on them. To be able to supply reasonably sound figures on short notice, one must have systematized methods and working data. In a series of articles to follow, techniques and cost tables for use in preliminary estimating will be reviewed. Prior to these discussions, however, one should consider the prerequisites for this field of estimating.

Providing estimating services is no job for the novice, nor for one unschooled on different types of installations under varying working conditions. Preliminary estimating is a task for an expert possessing plenty of tact and diplomacy. He must be able to "hold customers down" long enough to secure the necessary data to enable him to prepare an accurate preliminary figure in the short time allotted.

Cost Tables Simplify Estimating

To speed up estimating, tables of unit costs representing logical divisions or sections of an electrical installation can be developed. The contractor then will be able to give a price on a certain size service, motor, etc., much the same as a machinery dealer quotes on a lathe or planer. Authentic, established, over-all costs such as these, arranged in table form, are impressive and frequently swing a contract.

Figure 1 illustrates a typical power layout and shows the logical "sections" for which unit cost data sheets could be developed. Figures 2 and 3 are sample unit cost sheets for 3-phase, 3-wire services and motor installations. These will be explained in detail in future articles. Figure 4 illustrates a sample preliminary estimate compiled from these sheets.

In the rush to prepare an estimate it is easy to inadvertently omit such items as fuses; mounting frames, metering equipment, etc. In comparison to the total job, the cost of such

items might seem very small. However, when analyzed with the return ordinarily realized by electrical contractors these amounts may become quite significant.

Tables, such as those illustrated, should be developed in a systematic manner for each logical division of an electrical installation. The unit costs should be adjusted, at the time of estimating, to the particular job being considered.

It is acknowledged that much time and effort is required to develop such a set of tables. There are periods in the electrical construction cycle when the necessary time can easily be spared. At times contractors complain of lack of activity, worry over the evil practices of competitors, and even indulge in a bit of "wishful thinking." Such wasted hours could be directed into productive channels—the new development of cost studies and work sheets in preparation for the future.

Value of Cost Studies and Tables

Development of cost studies and tables provides more than mere estimating instruments. It keeps estimators alert, stimulates thinking that leads to better construction practices, and enables them to perform their regular work more expeditiously. The experience of contractors prepared to supply field estimates indicates that well organized cost sheets are an important aid to selling and to the establishment of better prices.

The buyer has more confidence in an estimate compiled from authentic units listed in a presentable table. He feels that such figures are more or less authentic and standard in the trade; that other reliable contractors would have comparable units (the unit cost sheets to be discussed in these articles were based on actual experiences of members of the Electrical Contractors Association of City of Chicago and compiled with the aid of the Chicago Electrical Estimators Association).

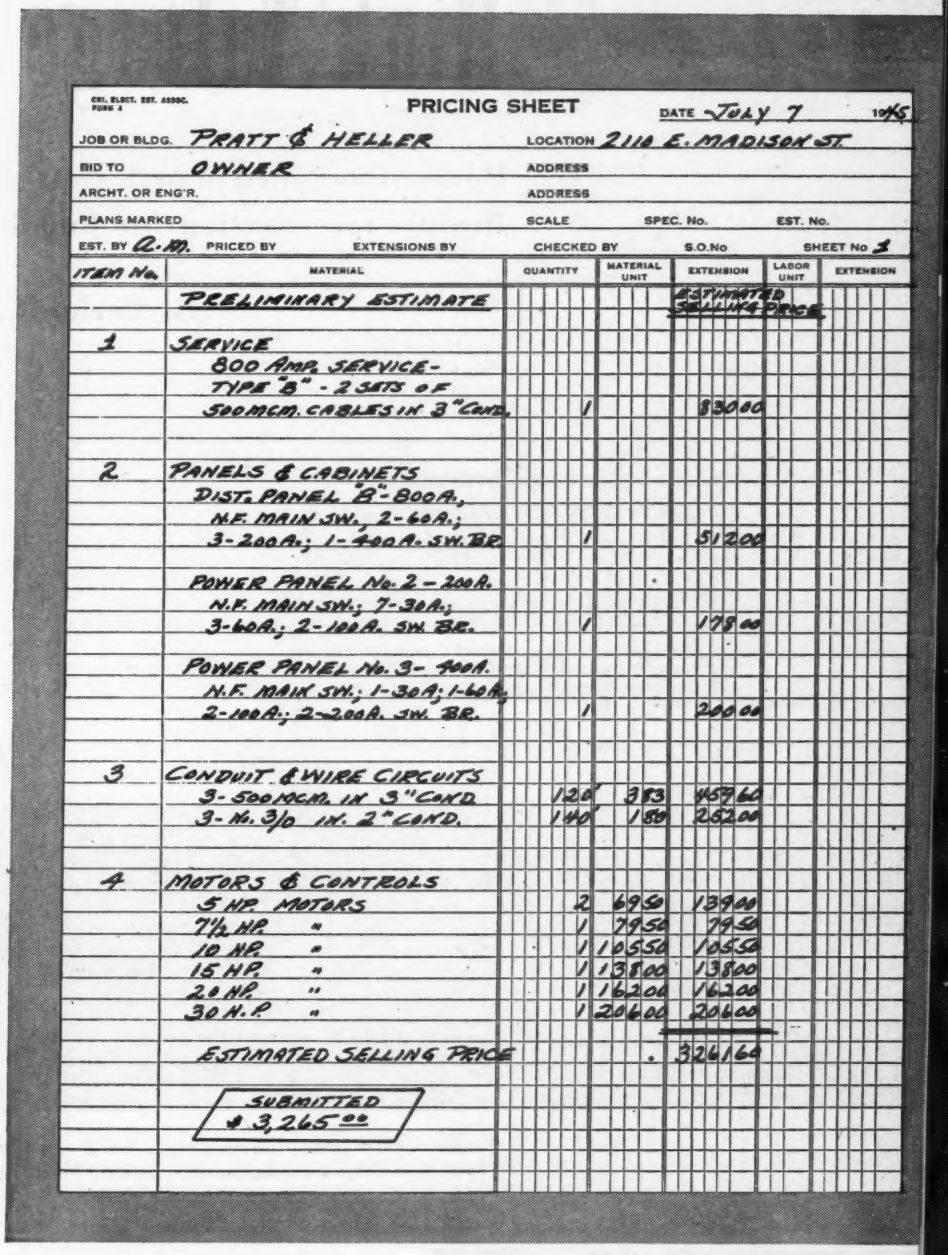
Winning Buyer's Confidence

A buyer is willing to pay a price he knows is right. Too frequently, however, he underestimates electrical work and views the contractor's seemingly high figure as an attempt to "load" the job and play too safe. If the contractor's price were backed up by authentic established unit cost figures, the buyer might be convinced of his error of underestimation.

Established unit cost sheets go far toward settling disputed costs of "extras." It's far more difficult for a buyer to discredit established unit costs than it is for him to disallow a contractor's individual figures. With unit cost sheets, the contractor has the experience of numerous other contractors to back up his price—a cost base that is difficult to dispute. Under these conditions the owner is more apt to agree that the price is in line.

Unit cost sheets frequently permit a contractor to establish a substantial "upset" price on a specific installation and subsequently secure the contract on that basis. Possession of unit costs, including all basic costs and mark-ups, eliminates the necessity of working out all the numerous details to establish a preliminary figure.

Contractors have everything to gain and nothing to lose when developing these unit cost sheets. The experience and knowledge gained during the preparation of the sheets is substantial return for the time effort expended. By acquiring a good background knowledge of costs, the contractor will be able to discuss his business more intelligently, impress the client with his knowledge of the electrical construction field, and have a much better opportunity to sell his services. At the same time, the contractor who substantiates his bids with well established, authentic cost units is doing much to foster better "going prices" in the industry.



CHI. ELECT. EST. ASSOC. FORM 1

PRICING SHEET DATE July 7 1945

JOB OR BLDG. Pratt & Heller LOCATION 2110 E. Madison St.

BID TO Owner ADDRESS

ARCHT. OR ENG'R. ADDRESS

PLANS MARKED SCALE SPEC. No. EST. No.

EST. BY A.M. PRICED BY EXTENSIONS BY CHECKED BY S.O.No SHEET No. 1

ITEM No.	MATERIAL	QUANTITY	MATERIAL UNIT	EXTENSION	LABOR UNIT	EXTENSION
	PRELIMINARY ESTIMATE			ESTIMATED SELLING PRICE		
1	SERVICE					
	800 AMP. SERVICE - TYPE "B" - 2 SETS OF					
	500 MCM. CABLES IN 3" COND.	1		830 00		
2	PANELS & CABINETS					
	DIST. PANEL "B" - 800 A.,					
	N.F. MAIN SW., 2-60 A.;					
	3-200 A.; 1-400 A. SW. BR.	1		512 00		
	POWER PANEL No. 2 - 200 A.					
	N.F. MAIN SW.; 7-30 A.;					
	3-60 A.; 2-100 A. SW. BR.	1		178 00		
	POWER PANEL No. 3 - 400 A.					
	N.F. MAIN SW.; 1-30 A; 1-60 A;					
	2-100 A.; 2-200 A. SW. BR.	1		200 00		
3	CONDUIT & WIRE CIRCUITS					
	3-500 MCM. IN 3" COND.	120'	3 83	457 60		
	3-No. 3/0 IN 2" COND.	140'	1 89	262 00		
4	MOTORS & CONTROLS					
	5 HP. MOTORS	2	69 50	139 00		
	7½ HP. "	1	79 50	79 50		
	10 HP. "	1	105 50	105 50		
	15 HP. "	1	138 00	138 00		
	20 HP. "	1	162 00	162 00		
	30 H.P. "	1	206 00	206 00		
	ESTIMATED SELLING PRICE			3261 60		
	SUBMITTED $3,265.00					

FIG. 4—Complete estimate of a preminary type using unit prices of various cost sheets previously developed (see circled items in Fig. 2 and 3). Total cost can be figured in a short time.

High Voltage Distributio

Power distributed at high voltage to unit substations provides flexible reconversion for building planes at Curtiss-Wright.

By Berlon C. Cooper

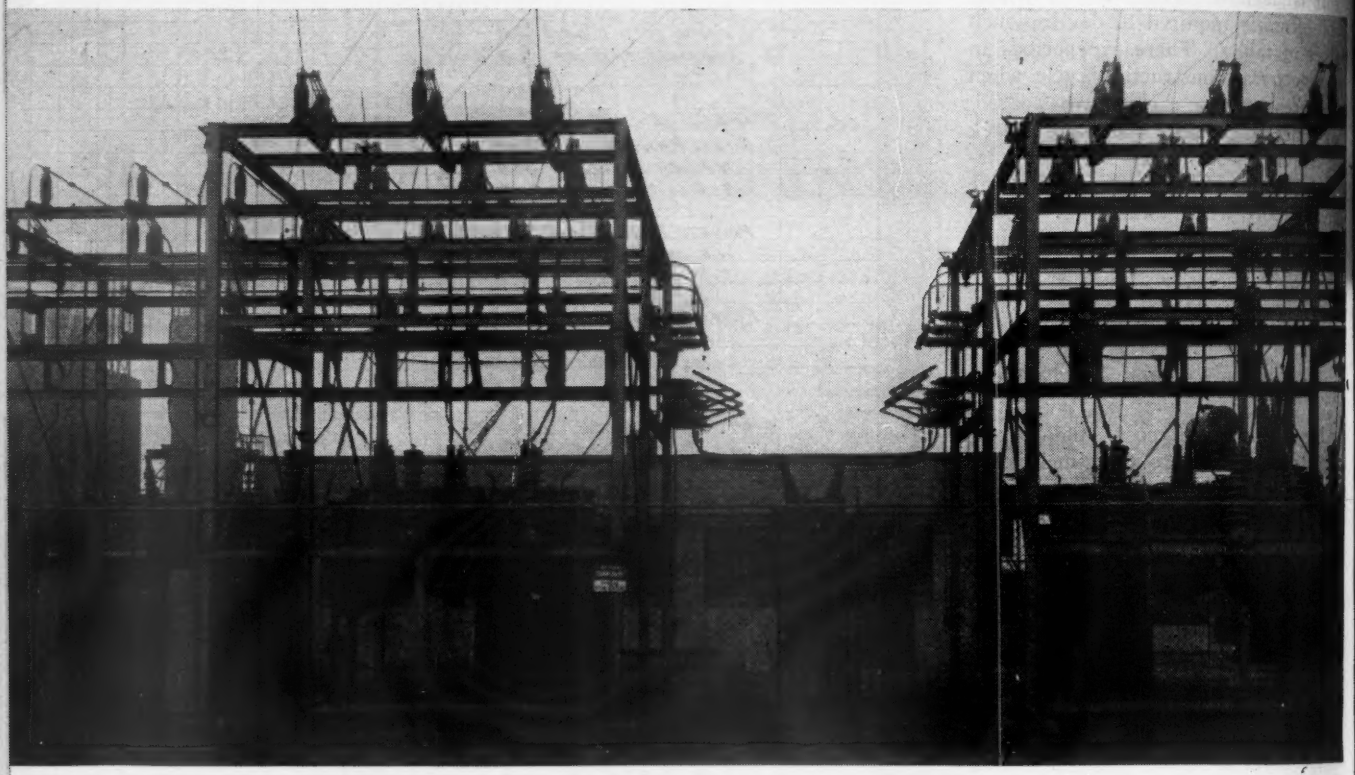


FIG. 1—Power transformer group serving plant No. 2 consists of five 1500 kva. units and one 7500 kva. unit (right background). Switch house is shown in background.

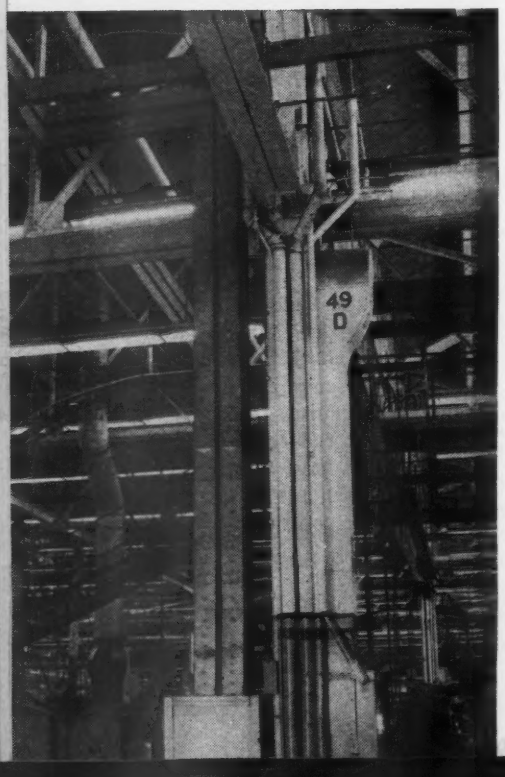


FIG. 2—Bus duct is shown rising (beside column) from substation in basement. These feeders are rated 500 amp., and service 250 amp. branch feeders located on ceiling trusses.

ELECTRICAL power layout for the Airplane Division plant No. 2 of Curtiss Wright was planned for both war and peace requirements. Adequacy of power supply and flexibility of distribution were the keynotes for design, planned by Albert Kahn, Associated Architects and Engineers, Inc., Detroit. The Buffalo, N. Y. plant, where P-40 and C-46 planes were produced, will now build the commercial version of the Curtiss Commando transport plane for the airlines.

The electrical work, comprising the original contract and subsequent additions, has totalled over three million dollars. This work was divided between three local contractors. These contractors were: Buffalo Electric Company, Inc., approximately 50 percent; Ferguson Electric Construction Company, approximately 25 percent; and Volker Bros., approximately 25 percent.

Power was first turned on in this plant in May, 1941. Two 1500 kva., 33,400 volt primary transformers served the plant at that time. Due to rapid plant expansion, and large load increases, made necessary by military demands for increased production, three additional 1500 kva., 33,400 volt primary transformers were added. Eight unit substations were located throughout the plant, and power supplied to each unit substation at 4800 volts, 60 cycle, 3 phase, 3 wire. One 750 kva. transformer for power, and

Builds Transport Planes

FIG. 3—Typical view in high bay area of plant. Note rectified fluorescent lighting for this area. Low bay areas are lighted with 2-lamp 40 watt fluorescent continuous row equipment.

one 500 kva. transformer for lighting, were installed in each substation. Fig. 9 shows the wiring and control layout for the five power transformers and eight unit substations.

A new research laboratory, known as plant No. 5, was built. This laboratory houses a duplicate of the Caltech wind tunnel in Pasadena, California. It is located across the highway from Plant No. 2. Because of the demand for well-regulated power to operate this huge wind tunnel, a new 115,000-volt line was installed by the electric utility company. Power demands in plant No. 2 continued to grow. In order to maintain adequacy of power supply, two 7500 kva., 115,000 volt primary transformers were installed, one at Plant No. 5, and the other at Plant No. 2. These transformers were designed for parallelling, assuring continued operation of either plant, in case of failure of either transformer.

A further step of precaution and flexibility was made when the 7500 kva. transformer was installed at plant No. 2. Switching was arranged so that normally one-half of the bus could be operated on the 115,000 volt line, and the other half on the 33,400 volt lines, which split in two sections at the last utility pole. In case of power failure in the 1500 kva. bank, the entire load can be connected to the 7,500 kva. transformer, and additional load may also be switched to the 7500 kva. transformer at Plant No. 5. Fig. 6 illustrates this flexibility and adequacy in power supply.

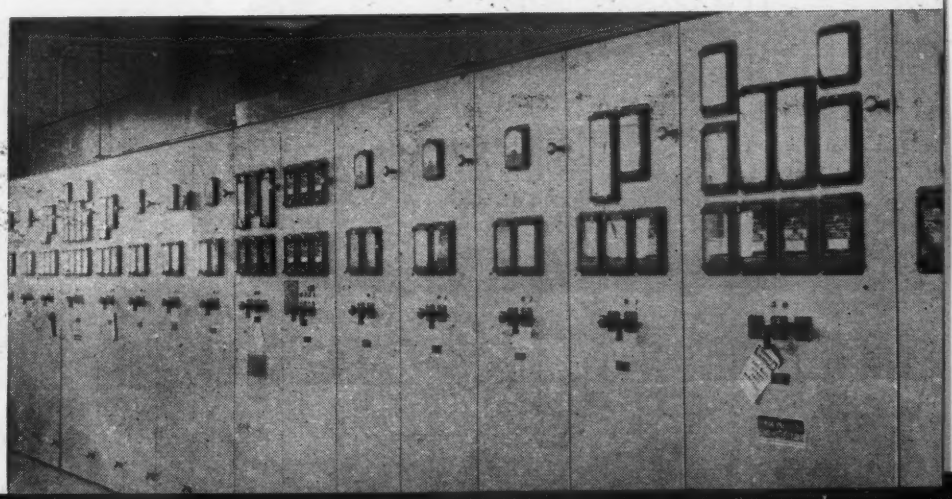
The 7500 kva. transformer, and the 1500 kva. transformers are connected delta-to-delata, with 4800 volt secondary, 3 phase, 3 wire. Pyranol capacitors correct power factor to approximately 95 percent, and are connected on the 4800 volt secondary side of the transformers.

Lines from transformers to switch house consist of 3 conductor 350,000 CM 8000 volt VC & L in fibre conduit. Switchgear, shown in Fig. 4, controls lines to unit substations. Lines from switch house to each unit substation consist of 3 conductor 350,000 CM 8000 volt VC & L in fibre conduit, buried in concrete tunnels beneath the building.

Typical unit substations house one power distribution transformer and switchgear (see Fig. 7) and one light distribution transformer and switch-

FIG. 5—Power from 7500 kva. and five 1500 kva. transformers is metered on this panel. (Above)

FIG. 4—Large panel board for switchgear, controlling power to unit substations.



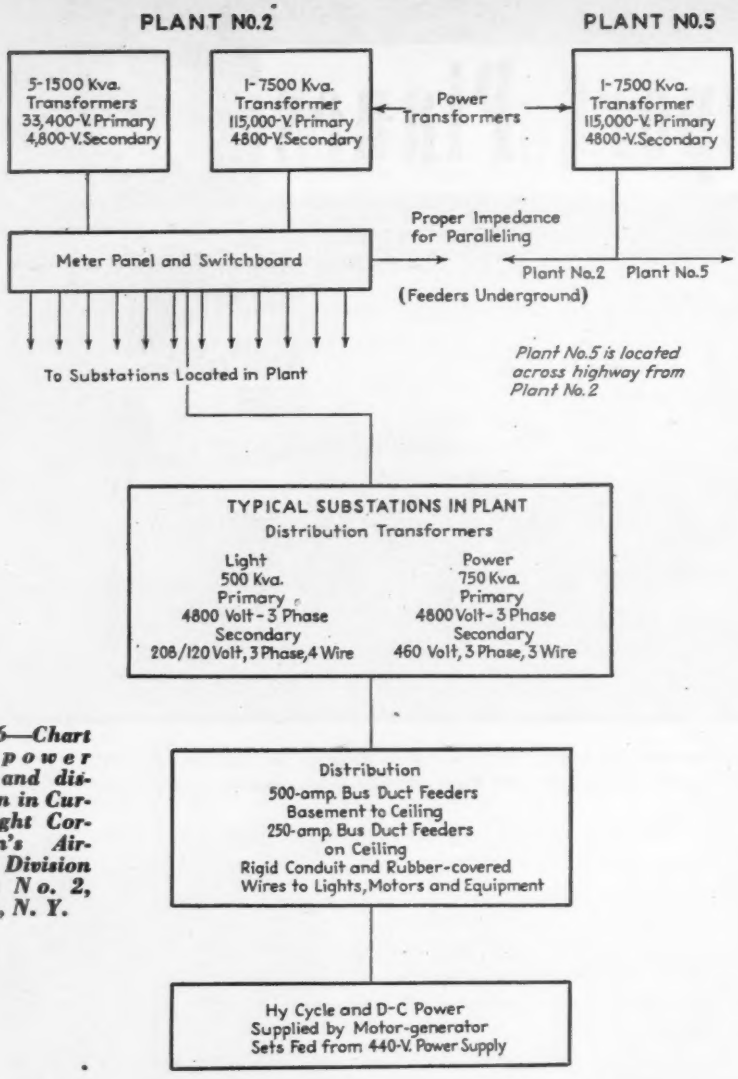


FIG. 6—Chart shows power supply and distribution in Curtiss-Wright Corporation's Airplane Division plant No. 2, Buffalo, N. Y.

gear (Fig. 8). The power distribution transformer is rated 750 kva., 4800 volts to 440 volts, 60 cycle, 3 phase, connected delta-to-delta. The light distribution transformer is rated 500 kva., 4800 volts to 208/120 volts, 60 cycle, 3 phase, connected delta to wye. Secondary breakers for power or lighting are rated 1600 amps., and are 440 or 600 volt air circuit breaker type, with 40,000 amps. short circuit capacity. Switchgear for secondary power feeders are 600 amp. air circuit breakers, and for secondary lighting feeders are 225 amp. air circuit breakers.

Protection against outages, or disruption of service, is assured by secondary tie feeders between unit substations. Groups of four unit substations are connected with secondary lighting tie feeders, and groups of two power transformers are connected with secondary power tie feeders. (Fig. 9 for details of lighting and power ties).

Secondary distribution from unit substations is by means of 500 amp. bus duct, directly connected to transformers. The bus duct rises from the transformer in the basement to the ceiling above (Fig. 2). Method of installation is shown in Detail X, Fig. 10. Area C, Fig. 10 shows typical branch feeder layout of 250 amp. bus duct from 500 amp.

(Continued on page 250)

FIG. 7—Power distribution transformer (at left) and switchgear (right). 1600 amp. secondary breakers are used. Transformer is 750 kva. 3 phase, 60 cycle. It is connected delta-to-delta to provide 440 volt, 3 phase, 3 wire power for motor loads.

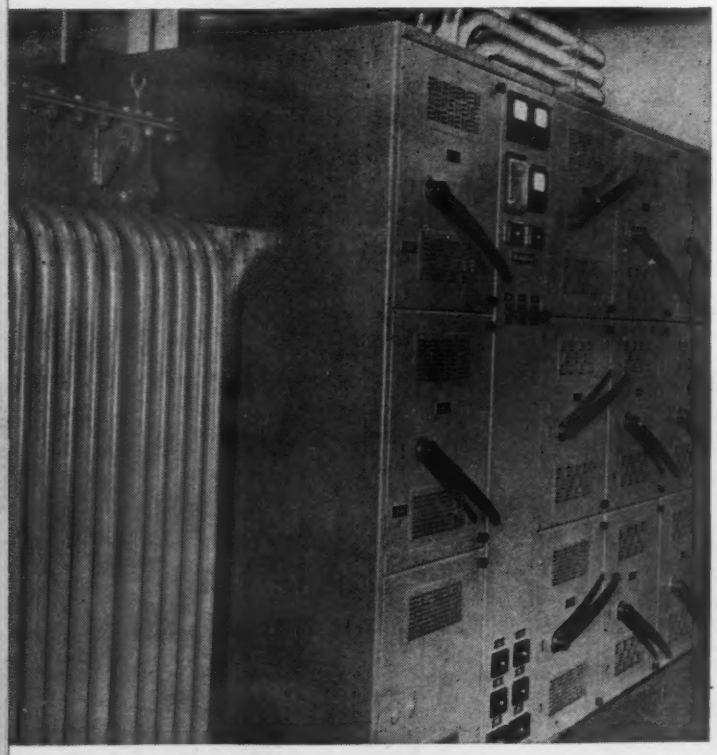
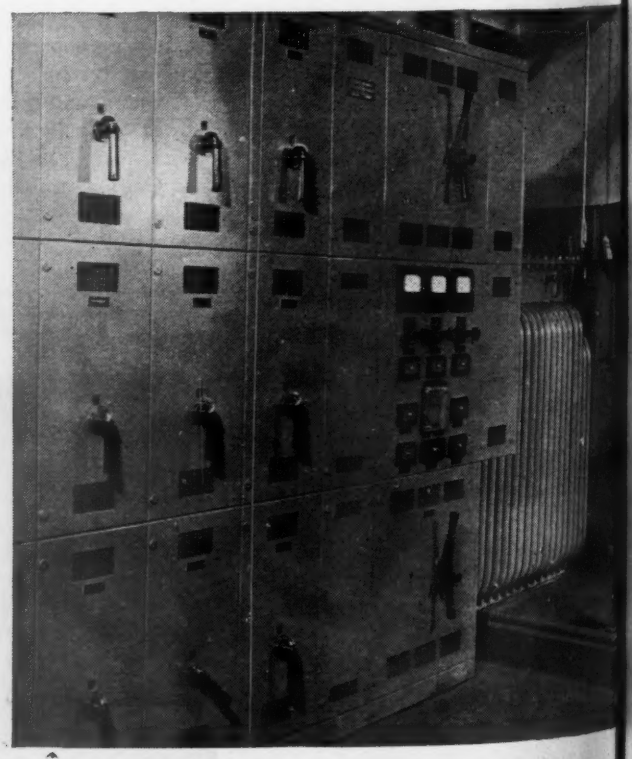


FIG. 8—Light switchgear, using 1600 amp. secondary breakers shown at left. Lighting transformer (right) is 500 kva., 3 phase, connected delta-to-wye. Primary is 4800 volts, 3 phase, 60 cycle. Secondary supplies 208/120 volt, 3 phase, 4 wire power for lighting load.



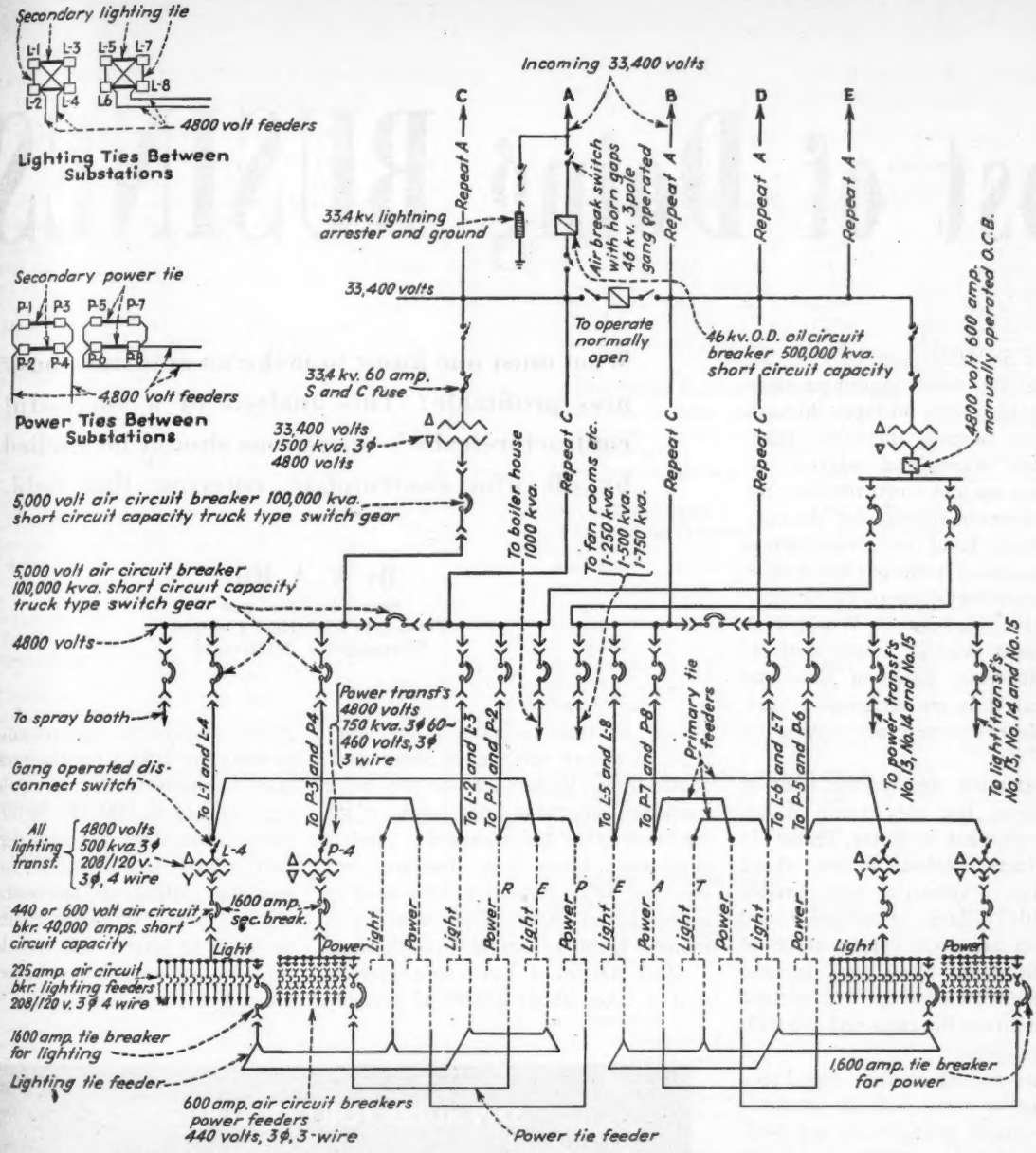
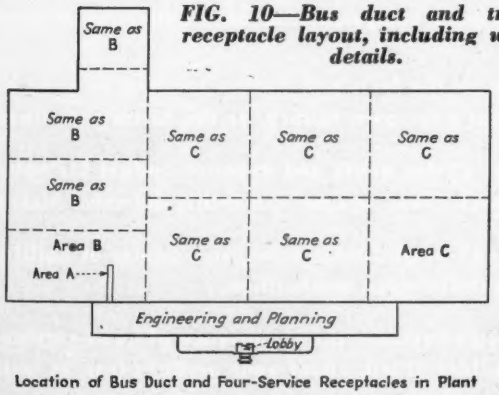
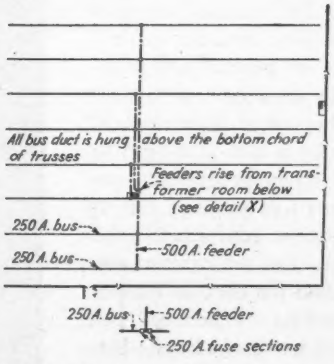

Secondary lighting tie
L-1 L-3 L-5 L-7
L-2 L-4 L-6 L-8
4800 volt feeders
Lighting Ties Between Substations
Secondary power tie
P-1 P-3 P-5 P-7
P-2 P-4 P-6 P-8
4800 volt feeders
Power Ties Between Substations
Incoming 33,400 volts
C A B D E
Repeat A
33.4 kv. lightning arrester and ground
Air break switch with horn gaps 46 kv. 3 pole gang operated
33,400 volts
To operate normally open
46 kv. O.D. oil circuit breaker 500,000 kva. short circuit capacity
4800 volt 600 amp. manually operated O.C.B.
33.4 kv. 60 amp. S and C fuse
33,400 volts 1500 kva. 3φ 4800 volts
Repeat C
To boiler house 1000 kva.
To fan rooms etc. 1-250 kva. 1-500 kva. 1-750 kva.
5,000 volt air circuit breaker 100,000 kva. short circuit capacity truck type switch gear
5,000 volt air circuit breaker 100,000 kva. short circuit capacity truck type switch gear
4800 volts
To spray booth
Gang operated disconnect switch
All lighting transf. 4800 volts 500 kva 3φ 208/120 v. 3φ, 4 wire
L-4
P-4
440 or 600 volt air circuit bkr. 40,000 amps. short circuit capacity
1600 amp. spec. break.
225 amp. air circuit bkr. lighting feeders 208/120 v. 3φ 4 wire
1600 amp. tie breaker for lighting
Lighting tie feeder
600 amp. air circuit breakers power feeders 440 volts, 3φ, 3-wire
Power tie feeder
Power transf's 4800 volts 750 kva. 3φ 60~ 460 volts, 3φ 3 wire
To L-1 and L-4
To P-3 and P-4
To L-2 and L-3
To P-1 and P-2
To L-5 and L-8
To P-7 and P-8
To L-6 and L-7
To P-5 and P-6
Primary tie feeders
To power transf's No. 13, No. 14 and No. 15
To light transf's No. 13, No. 14 and No. 15
Light
Power
1,600 amp. tie breaker for power

FIG. 9—Wiring diagram and control equipment layout for five 1500 kva. power transformers and unit substations located throughout plant

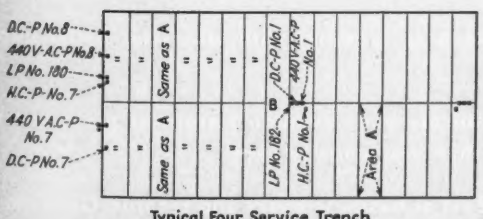
FIG. 10—Bus duct and trench receptacle layout, including wiring details.



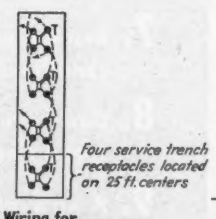
Location of Bus Duct and Four-Service Receptacles in Plant


All bus duct is hung above the bottom chord of trusses
Feeders rise from transformer room below (see detail X)
250 A. bus
500 A. feeder
250 A. bus
500 A. feeder
250 A. bus
250 A. fuse sections

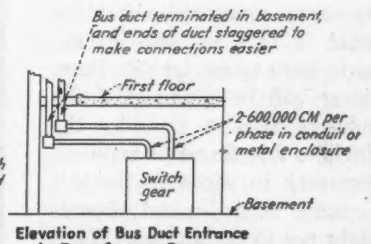
Typical Bus Duct Feeder Layout Area C



Typical Four Service Trench Receptacle Layout Area B



Wiring for Trench Receptacles Area A


Bus duct terminated in basement, end ends of duct staggered to make connections easier
First floor
2-600,000 CM per phase in conduit or metal enclosure
Switch gear
Basement

Elevation of Bus Duct Entrance to Transformer Room Detail X

- Hy-cycle receptacle, 10 A. 440 V. 4 P. 3 wire, polarized
- 2 gang twist lock 120 V. lighting receptacle
- A.C. receptacle, 10 A-440 V. 4 P. 3 wire, polarized
- D.C. receptacle 20 A. 250 V. 3 P. 2 wire, polarized

All receptacles for the four services are installed in trench pockets in floor under removable covers

Cost of Doing BUSINESS

What must one know to make an appliance business profitable? This analysis of a successful contractor-dealer's operations should be studied by all who contemplate entering this field.

By W. A. Ritt
Secretary-Manager
Minnesota Electrical Council
Minneapolis, Minnesota

BUSINESSMEN everywhere are facing the most important decisions in their business history. Competitive factors, increased taxation, higher wages and salaries, increased cost up and down the line, the threat of lower margins, plus the continued heavy hand of governmental regulation, rule out the old hit-or-miss methods of doing business which characterized the era between World War I and World War II. Such methods were a senseless waste of time and money and it is encouraging to note that people everywhere are waking up to it.

These failures weren't the fault of the business, but the result of ignorance—or what is worse, refusal to face the facts. Refusal to plan ahead on the basis of known or ascertainable facts spells failure. Confidence and self respect are great capital assets to any businessman. You can't succeed without them and you can't have them unless you know the facts and are willing to face them.

Good accounting practice, based on a knowledge of facts, will do much to solve the major problems in any business. And in the appliance business, an educational program along these lines will certainly indicate the dangers of price cutting and a loose trade-in policy. You cannot prosper unless your competitors in general are prospering. To help ourselves, we must help others to be sound businessmen. The trouble has been that men tend to get discouraged when progress seems slow, when a small percentage fail to learn by experience or conform to good business practice. Let me caution you—it takes time and patience to correct ills of long standing. Whenever you give up trying to make conditions better, things may become worse than before.

We are much concerned about the future trend of this business—everyone seems to want to get into it. Postwar business will be dynamite if the entire industry fails to consider the basic principles and financial arrangements necessary to succeed. So let's consider some basic round figures which ought not to be ignored. When we know these figures and are convinced of their soundness we don't need to worry too much about new competition. Rather *we can feel more confident about our own future if we measure up to the standards. And if newcomers know these standards and measure up to them, we don't need to worry about them.* They won't risk money without careful investigation.

Most figures I have seen indicate that it takes about $5,000 of invested capital to provide employment for one person; the lowest for the retail appliance business is $3,500. Allowing a minimum of $1,000 for furniture, fixtures, store and business equipment, that would leave $2,500 for stock, working capital and accounts receivable, if any. Working capital ought to cover at least a full month's quota of salaries, rent and expenses, or at least $500 in a very small business.

TEN RULES FOR GOOD BUSINESS

1. After the requirements for adequate capital are met, good accounting is a prime essential in this business.
2. Helping competition to do a better job is good business.
3. Know the facts and figures relating to your business, either from your own history, or the history of others.
4. Set a sales quota and expense budget for your business and check these against a monthly business statement.
5. Don't overestimate salesman's quotas or ability; don't underestimate your competition.
6. Don't overlook the importance of good service as a business builder. It will affect your profit or loss, as well as your competitive position.
7. Resolve to keep on working with others for better business conditions.
8. Don't overestimate your average margin of profit and don't spend more than you actually earn.
9. Keep a good set of business books and records. Get a monthly statement and analysis of your business and compare it with your budget.
10. Be a good competitor, make a good living for yourself and help others to do the same.

TABLE I . . . ACTUAL FIGURES OF AN ELECTRIC APPLIANCE & SERVICE OPERATION

Averages for 12 Year Period 1929-1940

	(1) Annual Average 12 Years	(2) % of Gross Bus. Volume	(3) % of Net Mdse. Volume	(4) Range: Min. to Maximum
Business Volume	$40,183	(40,183)	(35,058)	24 — 55,000
Gross Annual Volume	5,025	12.2		3.5 — 9,000
Income from Labor	35,058			20 — 47,000
Net Mdse. Sales	4,844			3 — 9,000
Cost of Labor	181	0.5	0.5	
Gross Gain on Labor				
Cost of Merchandise	24,435			
Gross Margin (30.3%)	10,623			
Ovehead Expense	$	%	%	(hundreds)
Bookkeeping & Sales	1,876	4.6	5.4	7 — 28
Management (Owner's)	2,031	5.0	5.8	11 — 25
Rent & Heat	930	2.3	2.7	6 — 10
Light, Power, Telephone	293	0.7	0.8	2 — 4
Taxes on Mdse. & Equip.	248	0.6	0.7	2 — 4
Auto & Truck Expense	483	1.2	1.4	3 — 10
Freight, Express & Drayage	521	1.3	1.5	3 — 7
Insurance	378	0.9	1.1	3 — 5
Advertising	960	2.3	2.7	3 — 13
Office Supplies—Postage	313	0.8	0.9	1 — 5
Repairs on Bus. Equip.	90	0.2	0.3	0 — 3
Interest on Borrowed Capital	511	1.3	1.5	1 — 10
Bad Debts	200	0.5	0.6	1 — 4
Depreciation on Equipment	284	0.7	0.8	1 — 3
Assn. Dues—Licenses	180	0.4	0.5	0 — 3
Payroll Taxes (4 years Avg.) (Employers Share)	261	0.6	0.7	2 — 3
Totals	$9,559	23.6	27.6	
Less Net Gain on Labor	181	0.5	0.5	
Net Totals	$9,378	23.1	27.1	

Capital Structure, etc.

Owners Average Investment for Period	$20,000.00
Borrowed Capital (Carrying Contracts)	12,000.00
	$32,000.00

Distribution of Investment

Merchandise, Average Inventory	$14,000.00
Fixtures & Equipment (Orig. Cost)	4,500.00
Accounts & Contracts	12,000.00
Avg. Surplus & Balances	1,500.00
	$32,000.00

Average Number of Employees SIX. Avg. Investment per employee—$5,333.
Average Annual Net Profit on Sales—3.2%
(Range 15% loss to 9% gain)

TABLE II . . . POSTWAR SALES QUOTA & OPERATING BUDGET

Average for first 3 postwar years

Business Volume, etc.	One Dealer's Estimate Quota	One Dealer's Estimate % of net Mdse. Sales	Your Own Estimate Quota	Your Own Estimate % of net Mdse. Sales
Gross Annual Volume	$75,000.00			
Labor Service Income	12,000			
Net Sales of Mdse.	63,000			
Est. Average Margin on Sales	21,000	33.3		
Labor Service Cost	10,800			
Labor Service Margin	1,200	2.0		
Total Gross Margin		35.3		
Overhead Cost of Doing Business				
Sales Expense & Office Salaries	$5,670.00	9.0		
Management (Owner's Salary)	3,150	5.0		
Rent and Heat	1,890	3.0		
Light, Power & Telephone	500	0.8		
Taxes	380	0.6		
Auto & Truck Expense	1,260	2.0		
Freight, Express, Drayage	945	1.5		
Insurance	630	1.0		
Advertising	1,575	2.5		
Office Supplies	500	0.8		
Repairs	190	0.3		
Interest	315	0.5		
Bad Debts	315	0.5		
Depreciation	500	0.8		
Assn. Dues, Licenses	315	0.5		
Payroll Taxes	690	1.1		
Total	$18,825.00	29.9		
Gross Margin (21,000 plus 1,200)	$22,200.00	35.3		
Net Margin	3,375	5.4		
Plus Interest & Discount Earnings	950	1.5		
Net Business Earnings	4,325	6.9		
Capital Investment				
Merchandise Inventory	$20,000.00			
Fixtures, Trucks—Equipment	6,000			
Accounts & Notes Receivable	15,000			
Working Capital	4,000			
	$45,000			

Employees:
- 2 Salesmen
- 1 Bookkeeper
- 1 Manager
- 5 Service Mechanics
- 1 Delivery & Porter

10—Investment per employee—$4,500.00

That would leave $2,000 for a stock of refrigerators, freezers, ranges, washers, ironers, small appliances, radios, phonographs, and miscellaneous supplies, and one can't face postwar competition with this small stock.

You may be able to get credit on open account or floor plans, but it still takes the same amount of capital—yours or someone else's.

How much business can one man do with a $5,000 investment? The National Retail Hardware Assoc. Survey for 1943 shows a range of $10,400 to $14,900 annual *sales per employee.* But that includes a lot of little stuff. Let's say one man can run a business with all of its details and still sell $15,000 worth of appliances a year. Many smaller unit sales will drag the average down. I doubt if one man could run even this size of business, take care of the books, attend to the deliveries, buying, collections, etc.

How rich can a one-man operator become out of a $15,000 annual volume producing about a $5,000 gross margin, or at best about $2,500 net—for salary and profit, including interest on investment. Would you work that hard for someone else for that money and risk your capital or savings too?

It takes more than a one-man operation to make any real money in this business. Here the fun begins. Capital requirements add up at the same rate, about $5,000 per man, but the sales don't always increase at the rate of $15,000 per man. The average salesman is not that good. The 1944 Survey of the National Retail Hardware Association shows an investment of about $4,900 per $10,000 sales volume. Against an average sales volume of $12,000 per employee, according to their figures, we again find a capital investment which closely approaches $6,000 per employee.

Check and see how many two-employee establishments do $30,000 a year volume, and what their capital investment amounts to. The average business volume of all retail establishments in the U. S. is far under $50,000. You will find in the average $50,000 a year appliance business *at least* two salesmen, a serviceman, a bookkeeper-stenographer, besides the owner or general manager. And believe it or not, many of the owners or general managers draw little, if any more—sometimes not as much, as the head salesman, and without figuring interest on their investment. Why should the owner or the partners run the busi-

ness and not draw at least as much as they would pay someone else to do the same work—plus a reasonable return on invested capital?

Most businessmen are reluctant to divulge facts and figures regarding their business. A business census enumerator a few years back confirmed my suspicions that *many businessmen simply don't have any figures or else their accounting is so jumbled that the figures can hardly be unscrambled.* Although unbelievable, it is all too true in most small and many large businesses.

Actual Business Analysis

Let's consider an actual set of figures and simple percentages taken from the records of an individual appliance dealer's business for the 12-year period, 1929-1940 (Table I). Such records are extremely valuable in forecasting future operations. We should show every year's individual figures to really analyze the trend, but space permits only this digest. *Long-range business planning cannot be done on the basis of one or two good or bad years. We must consider the record or prospects for a number of years—good, bad or indifferent—to really get an over-all picture.*

This is an average business in many respects, certainly as to gross volume averaging $40,183, or $35,058 eliminating income from labor services. *This operator regards labor costs as only incidental to the sale of merchandise.* While some sidelines are being carried, *better than 65 percent of the total volume is in electrical appliances, radios, lamps, fixtures and supplies. Certainly a service set-up of some kind is necessary in any appliance dealer's business, and it is a life preserver in bad times as well as in time of war.* In normal times, especially in the future competitive market, service should be one of the appliance dealer's greatest assets. The income from labor services above is set against the raw cost of labor—the direct payroll. All payroll taxes and other related service expenses are included in the various items of overhead cost. The slight margin of labor income over labor cost goes to reduce overhead; in this case by an average of half of 1 percent, an almost insignificant amount. The employees whose wages are charged against labor cost do some selling and perform many services incidental to unpacking, delivering and guarantee servicing. *If there was a loss on labor income it would seem to be a legitimate addition to general overhead or selling costs.* More complete accounting of these costs—a separation of service income, producing and selling functions would be desirable, but would not alter net results.

I have not seen this method of accounting for income and cost of services expounded before, but it has much to commend further study. The soundness of this service accounting theory may find some proof in the present case. During the four wartime years (1941-1944) average annual gross volume was $53,416; labor income over $11,000 against less than $10,000 cost of labor; overhead was kept down to less than 28 percent and net profits increased to nearly 7 percent. There is another story back of that, but the figures are distorted by wartime conditions so they would add little value to our present discussion, except to indicate what a consistently good service policy may mean to a business in time of stress.

To prove how misleading overhead figures can be, the percentages in the second column are based on total gross volume, *although 12 percent of the total volume is covered by a practically non-profit item of labor or service income.* These second column figures should therefore be disregarded. Since you can't pay expenses out of non-profit items, *the overhead should be and is here properly figured against the net merchandise volume as shown in Column 3,* arriving at a total of 27.6 percent, or 27.1 percent by deducting the slight gain on labor income over the cost of such labor.

The individual items of overhead have varied in amount by as much as 700 percent during 12 years. The owner projected each year's volume of business and tried to adjust expenses accordingly. The years 1932, '33 and '34 were critical ones in which fixed expenses against "depression-low" volumes caused losses running as high as 15 percent of gross business in 1933. Taking that into consideration, the low net profit average of 3.2 percent on sales—reflecting a fairly satisfactory margin in good years—left this operator in a position to meet wartime conditions in 1941. What the result would have been without careful planning and charting is not hard to figure out. As it was, he could live fairly well in his particular community on the management fee, and he added an average of about $1,245 per year to his net worth. This is the kind of business in which tens of thousands of people, it seems, expect to get rich quickly. Most certainly there is no room for much price cutting or foolish trade-in deals.

Dun & Bradstreet's 1940 Retailers Operating Cost Survey for Electric & Gas Household Appliance Stores shows that out of 391 retailers reporting an average volume of $24,000 sales for 1939, 40 percent reported losses averaging 5.5 percent with 60 percent reporting an average profit of 7 percent. The unprofitable operators showed an overhead expense of 37.4 percent on sales and profitable operators had kept their overhead down to 30.4 percent. Out of the 7 percent excess overhead cost for unprofitable operators, 5 percent showed up as salaries and wages.

This brings up the question of compensation for salesmen. *It will take more than 10 percent commission to attract and hold good salesmen.* You may be able to pay 15 percent if you can keep your average selling cost down below 10 percent but beware of the 50-50 split on gross margins and some of the other deals which have wrecked many a good dealer. Just remember that $15,000 per year is a good average sales figure per retail salesman, so count on four sales people, or three besides the owner, to do a $60,000 annual volume. You will still need a bookkeeper, a serviceman, or two, and a general handyman. That's why sales quotas were put into this discussion of cost. You must know how many employees it takes to do a certain amount of business and you must anticipate a certain volume in order to budget your overhead expenses. Another good "rule of thumb" to note is—*management or store sales should account for at least 25 percent of the total volume in a successful business.* If store sales are less, the owner is probably working for the salesman, instead of vice-versa.

Charting Postwar Business

Now let's see how the above operator proposes to chart his postwar business. He is a bit conservative judging from the figures in Table II. He is estimating annual sales in the first three postwar years beginning with 1946, at only 30 percent more than his best prewar years. He estimates the number of employees needed to handle this business and he expects to pay them the best wage or salary which his community and his business affords. He knows his market quite well and

(Continued on page 248)

Electrical Contracting

OCTOBER · 1945

AN EDITORIAL FEATURE SECTION . . . light today . . . planned; detailed lighting studies: bowling alley, school, residence, store, drug store, showroom, factory and office . . . how to sell.

LIGHT TODAY

Trends point to planned lighting systems geared to modern living and working needs and applied to produce specific lighting results.

By W. T. Stuart

LIGHTING the factories, stores, offices, schools, churches, homes, recreation and service establishments of America in the months and years ahead is one of the greatest tasks ever tackled by the electrical industry. Four years of bare-bones war economy while lighting technology forged relentlessly ahead have created a huge potential market. Stocks of lighting equipment are at an all time low. Yet never before have we had such a wide variety of light sources, components and equipments with which to work. Nor have we ever before had such an opportunity—and responsibility—to establish a new era of illumination and a new concept of modern living to the whole nation.

To light America, to bring to the public the benefits of modern lighting technology, is primarily a practical job for practical men. It is not enough that our industrial laboratories can produce light sources of great efficiency. It is not enough that the manufacturers' designers produce luminaires of great beauty and usefulness. These products must be wisely selected, intelligently integrated, imaginatively employed, efficiently supplied with energy and effectively maintained in coordinated lighting systems. Here is the very heart of lighting progress. And the responsibility for lighting America rests with the men who will design, lay out, install and maintain the *planned lighting* systems that will bring the fruits of modern lighting technology to the public.

Larger Responsibility

This new and larger responsibility on the electrical contractor and master electrician for the effective application of modern lighting techniques is the logical result of recent progress. Today's trends show a preponderant emphasis on functional lighting, illumination geared to a specific lighting result, equipment coordinated with architectural features and lighting sytems far removed in concept and cost from previous conventional practices.

In the following pages we present a group of lighting projects carried out in general plan and in detail. They illustrate *planned lighting* from many angles. They represent the trends in modern lighting methods. They indicate the trends in light sources, components and equipments. They show modern ideas on layout.

Specific Lighting

In preparing this editorial project, we sought out eight prominent illuminating engineers. We placed before each of them a specific lighting job with a request that he design and lay out a practical lighting installation. We asked that the system shown and described be representative of the best modern lighting techniques, and that the light sources, components and equipments be within the scope of practical manufacture and installation.

In practically every case, the fixture designs are comparable in purpose and application with equipment currently catalogued or in process of design by well known and reputable manufacturers. In some instances fixtures are shown requiring special fitting and fabrication. This is entirely logical since it is unlikely that stock fixtures or components could be devised to fit all possible conditions. In other instances, fixture designs that may be special today are quite likely to appear as catalogued items as *planned lighting* systems stimulate demand.

Several aspects of the lighting treatment are particularly significant because they appear in widely different applications. In almost every instance, the design pattern shows continuous lines of light in preference to isolated lighting units. This is a natural trend resulting from the use of the longer fluorescent lamps, which lend themselves particularly well to line-of-light treatment.

It is also important to note that the systems generally avoid the conventional categories of direct and indirect lighting. The designers employ either or both together to achieve specific lighting results. In the same way both fluorescent and incandescent sources may be used together, or sections of cold cathode tubing in conjunction with standard hot cathode lamps. Since *planned lighting* is a practice of working back from a desired result, it is

entirely logical that the lighting equipment contributing to that specific result may involve several sources and fixture designs.

Another important trend is the emphasis on reduced brightness contrast and the swing away from "footcandle" designing. Since fluorescent sources make high intensity lighting both practical and economical, the production of raw footcandles assumes a secondary role to effective light control. Control is always obtained at the expense of light output with a consequent reduction in footcandles on the working plane. The elimination of glare and excessive brightness contrasts, however, greatly improves the net lighting result.

And what about cost? The installed price of *planned lighting* systems such as those illustrated in the following pages is substantially greater than pre-war practices. Superior lighting results can be obtained only with a correspondingly greater outlay for lamps, equipment, installation, labor and kilowatt hours. This trend in lighting progress should not be soft-pedalled or underestimated. It would be a serious mistake to allow customers to expect modern functional lighting systems at budget levels established when illumination was an insignificant item in the total construction estimate. Costs will run from twice to as much as ten times greater than those which were once considered average for the type of occupancy.

Wiring systems required are also substantially more elaborate, of greater capacity and consequently more costly. The cost of modern lighting systems should be presented boldly and courageously. The lighting results to be achieved are well worth the outlay. In much of the recent experience with *planned lighting* installations, it is clearly evident that the customers are more ready to accept the costs of good functional lighting than the industry is to accept the almost revolutionary new price levels involved.

End Product

Illumination is one of the great end products of the generation and distribution of electrical energy. A useful and attractive lighting result is the product of all the genius, engineering, planning and labor that has created and built the vast and complex system between the waterfall or steam turbine and the sales counter or schoolroom. Unless the lighting result is the best we know how to do, unless we bring to public use the latest and best in lighting technology, our vast systems of wiring distribution and generation are little more than monuments to our technical competence.

Conversely, however, as we gain confidence and knowledge in applying illumination methods to human needs, wants and comforts, the effect is felt throughout the electrical system. Modern illumination carries with it modern wiring, control methods, apparatus, new distribution schemes and new demands on generating facilities. No branch or part of the electrical industry can remain unaffected.

Lighting Interdependence

And in the field of illumination alone, no area of illumination practice can go forward without carrying the whole technology with it. The effect of high level industrial lighting in war plants has created a measurable demand for higher illumination levels in the homes of workers, in the offices of executives and in the business places of visiting tradesmen.

This factor of interdependence places a serious responsibility on everyone concerned with today's lighting installations. No job is too insignificant or isolated to deserve less than the best of able planning. Every job is an opportunity to contribute to the overall march of lighting progress.

Good lighting is contagious. It is the almost universal experience of industrial management that improved lighting in any department of the plant brings prompt improvement in output, together with pressure from foremen, superintendents and department heads for similar improvements in their departments. Labor unions are increasingly conscious of lighting as an important element of "working conditions". Enlightened management is more than ever before aware of the morale building effects of well designed and engineered lighting.

In commercial buildings, stores and shops competing for attention and trade, managers have already learned the potent power of effective lighting. One good *planned lighting* job on Main Street can influence illumination practice through the whole business community. Good illumination practices applied to schools and institutions create strong pressure from civic groups for a general overhauling of lighting standards. And all of these forces are working toward better lighting today, greater lighting markets and new areas of business opportunity for those willing to meet the challenge.

The apparent trends of lighting progress are opening up new horizons for the electrical industry. Those who will design, install and service the systems to meet the demands of the coming months and years will find many problems and many challenges. It will take more technical judgment, imagination, boldness and business enterprise than any market has ever demanded of us. But it is a job worth doing—and worth doing well.

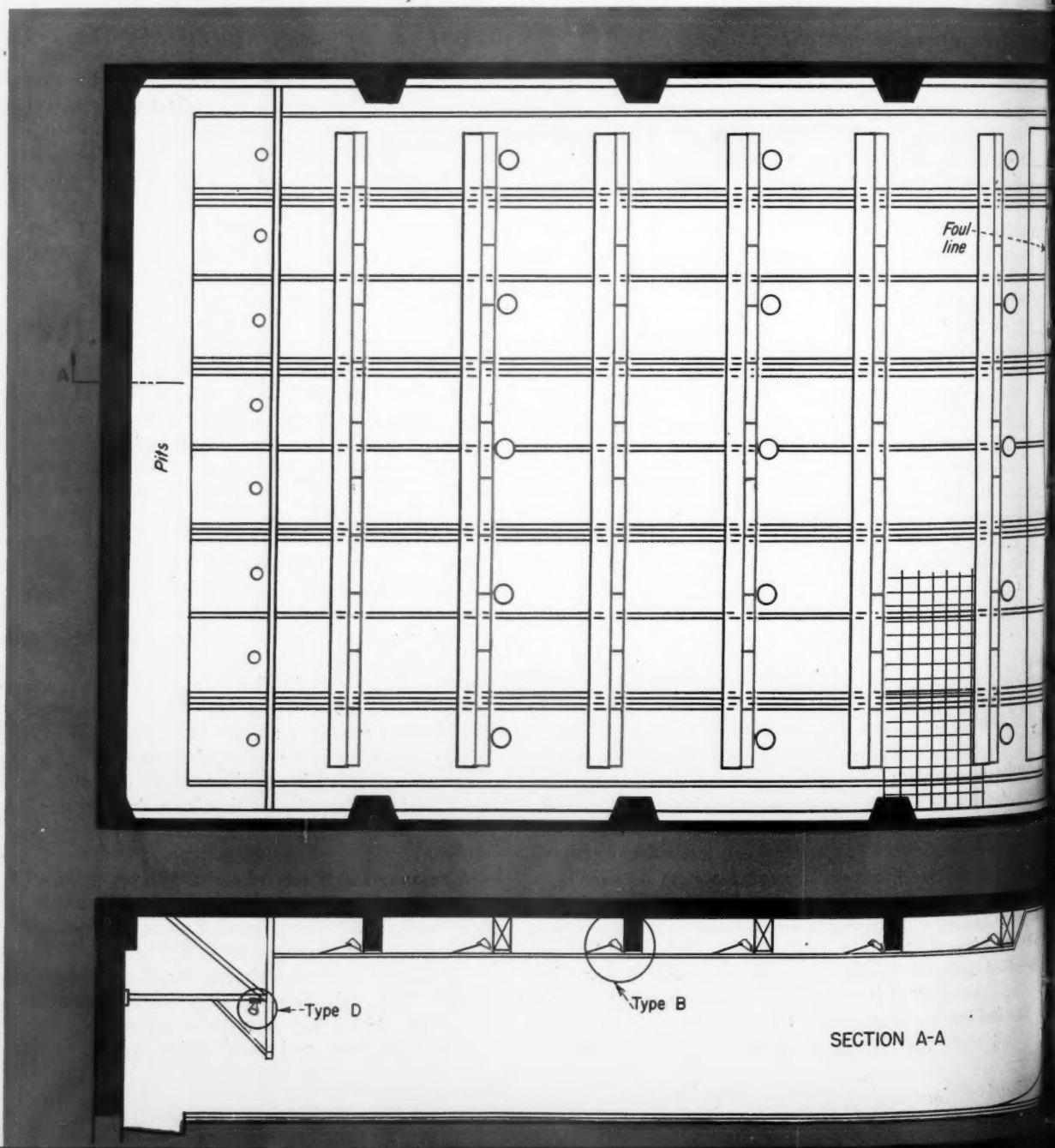
Planned BOWLING

BOWLING is fast becoming one of the nation's leading sports, participated in by both old and young, male and female. It is a thriving business. Competition between alleys is keen. And public demand is bringing strong pressure for modern lighting, air conditioning and sound proofing equipment, to make bowling a year round pleasure and diversion.

The bowling alley shown here, smaller than is normally found in metropolitan areas, illustrates the trend for lighting a building housing any number of alleys. It is lighted now with 150 watt angle reflectors on 15 foot centers, mounted eight feet above the floor, along the center of the alley. Ten footcandles of spotty illumination is the result. A 200 watt angle reflector mounted above and in front of pin positions provides approximately 75 footcandles on the pins.

Spectator and player areas are lighted with white enclosing glassware mounted on ceiling fitters, using 16 inch diameter glass globes and 200 watt lamps. These units are mounted on twelve-foot centers, resulting in glare and uneven illumination.

Typical of many alleys, draperies hang from the ceiling to within six feet of the floor, to act as light baffles and to reduce noise. These run at right angles to the alleys. In addition to being unsightly, these draperies prevent free air circulation.

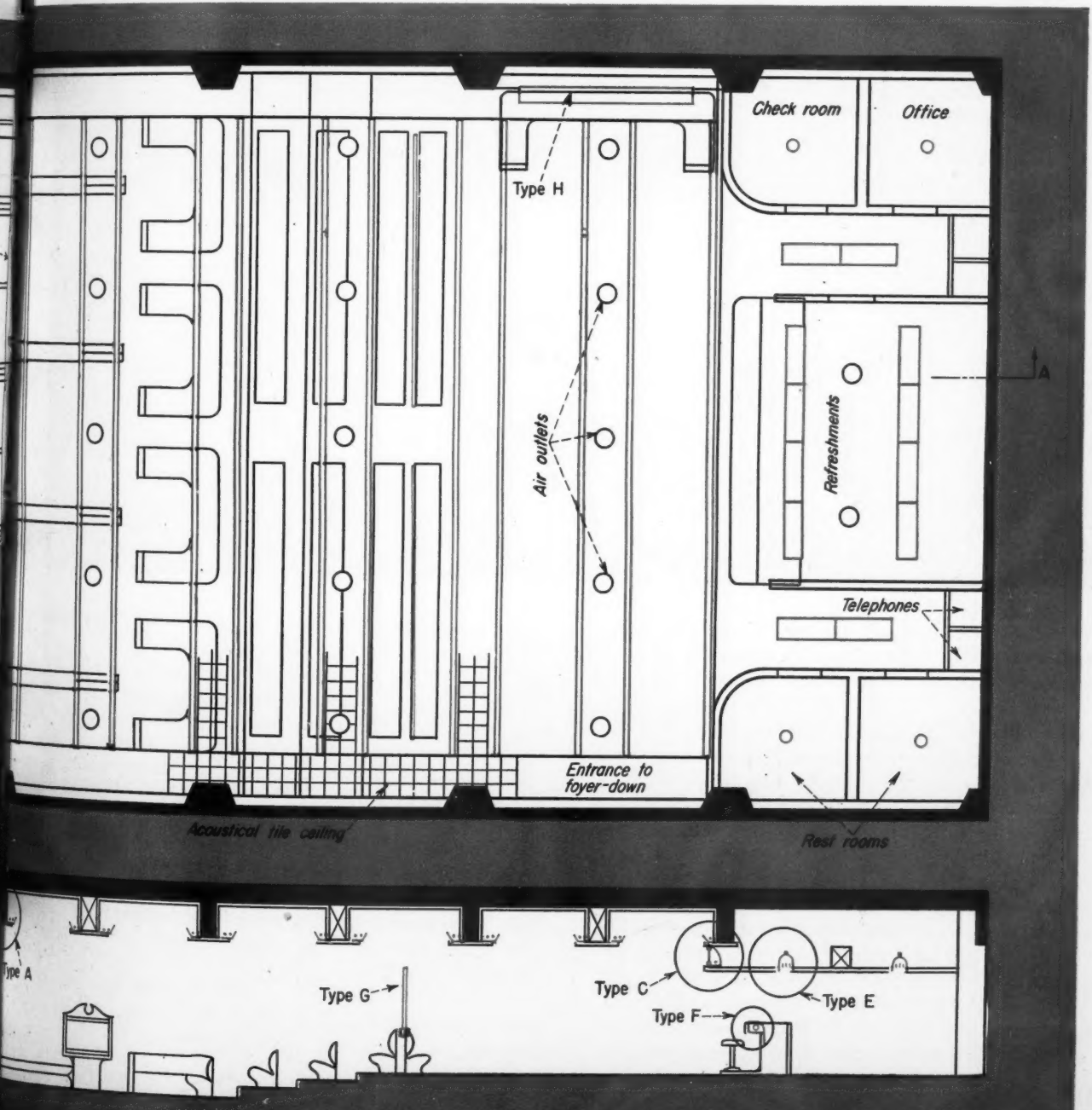


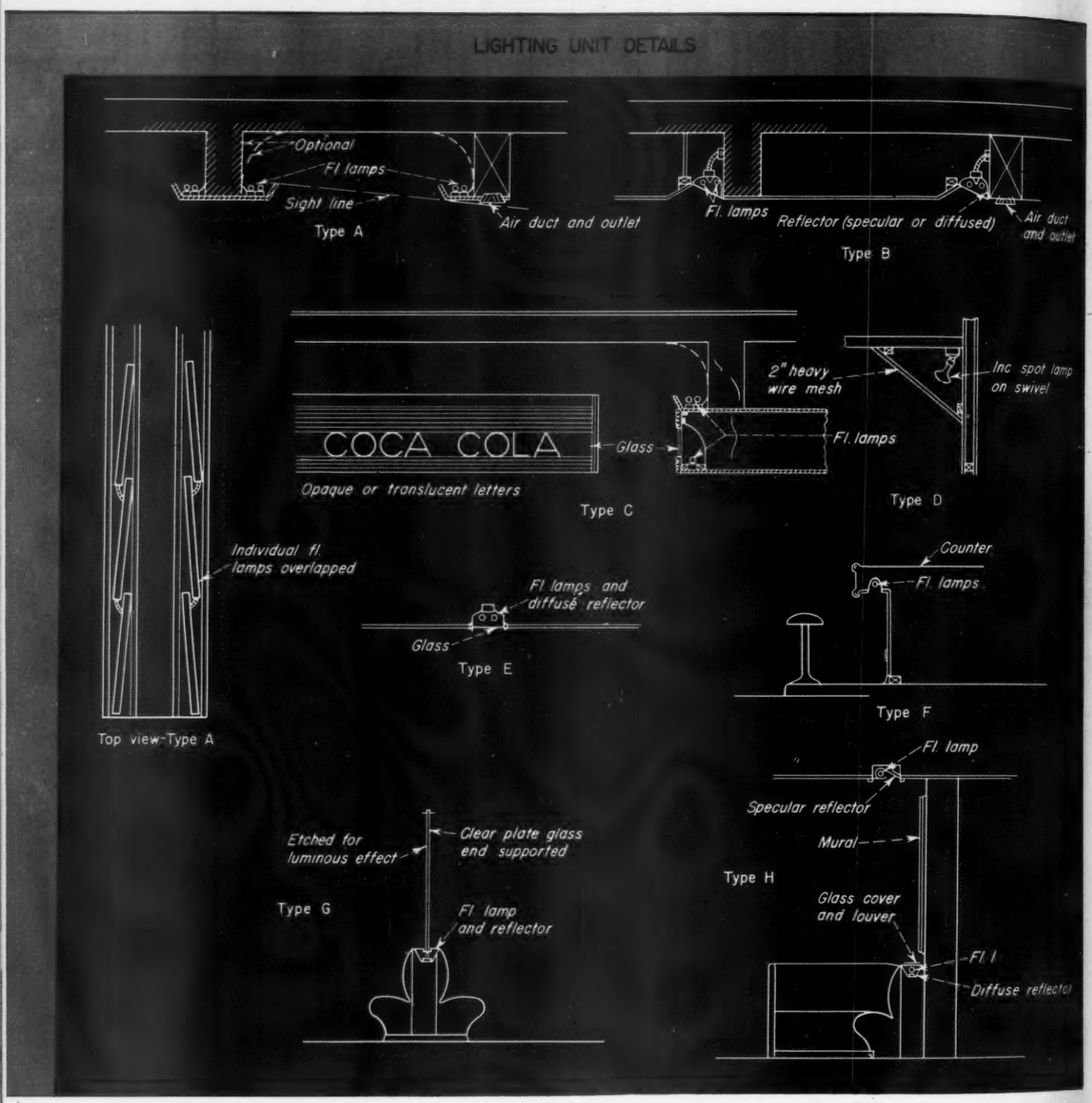
ALLEY LIGHTING

The first step in modernization of an alley is the will of the owners to make an expenditure with reasonable assurance of a fair return on their investment. Shown in the modernized layout of this alley are those features necessary for the comfort and convenience of patrons. They include adequate and comfortable spectator seating, refreshment stand, check room, and rest rooms, air conditioning and acoustical treatment, and *planned lighting* for the alleys and all facilities. All of these factors are important from the customer standpoint. *Planned lighting*, such as shown, provides adequate glare-free illumination for players, and creates a cheerful atmosphere for players and spectators.

The *planned lighting* installation is shown on the reflected ceiling plan and in the elevation. The various types of equipment have been identified on the ceiling plan and elevation by proper nomenclature. Details of each type are shown in enlarged scale separately.

Fixture A is designed as an integral part of the ceiling. It forms a coffer or cove lighting system over the player and spectator areas. Standard hot cathode type fluorescent lamps are shown in the drawing, but slimline or cold cathode type lamps may also be used. Sides of these coffers may be either curved or straight. The reflecting surfaces in either case should be white, with a mat (non gloss) finish. Use of a light color acoustical tile for the flat ceiling





portion of these coffers will maintain high lighting efficiency, and aid in noise reduction. Standard 40 watt white fluorescent lamps will provide a maintained intensity of 30 footcandles.

Fixture B lights the alleys. It consists of a continuous line of two-lamp 40 watt fluorescent lamps in a standard angle, or asymmetric, type trough. The estimated maintained average instensity is 38 footcandles. This is higher than planned for the spectator area, which will focus attention to the alleys.

Fixture C combines Fixture A and a luminous sign over the refreshment stand. In larger alleys, this sign effect may properly be carried across the entire building.

Pins are lighted by Fixture D to an intensity of 150 footcandles. The pins thus stand out in bold contrast, providing a well lighted target for the players. Fixture D is quite simple, consisting of a 150 watt reflector spot lamp in an adjustable swivel socket. Lamps should be protected against flying pins by a wire mesh guard. One lamp should be used over each alley.

Fixture E is a standard flush mounted unit, with hinged frame and diffusing glass panel. Each four foot length employs two 40 watt fluorescent lamps.

Fixture F lights the front vertical surface of the refreshment bar. It is located under the counter overhang. It consists of a continuous specular reflector elliptical in shape, for use with fluorescent lamps.

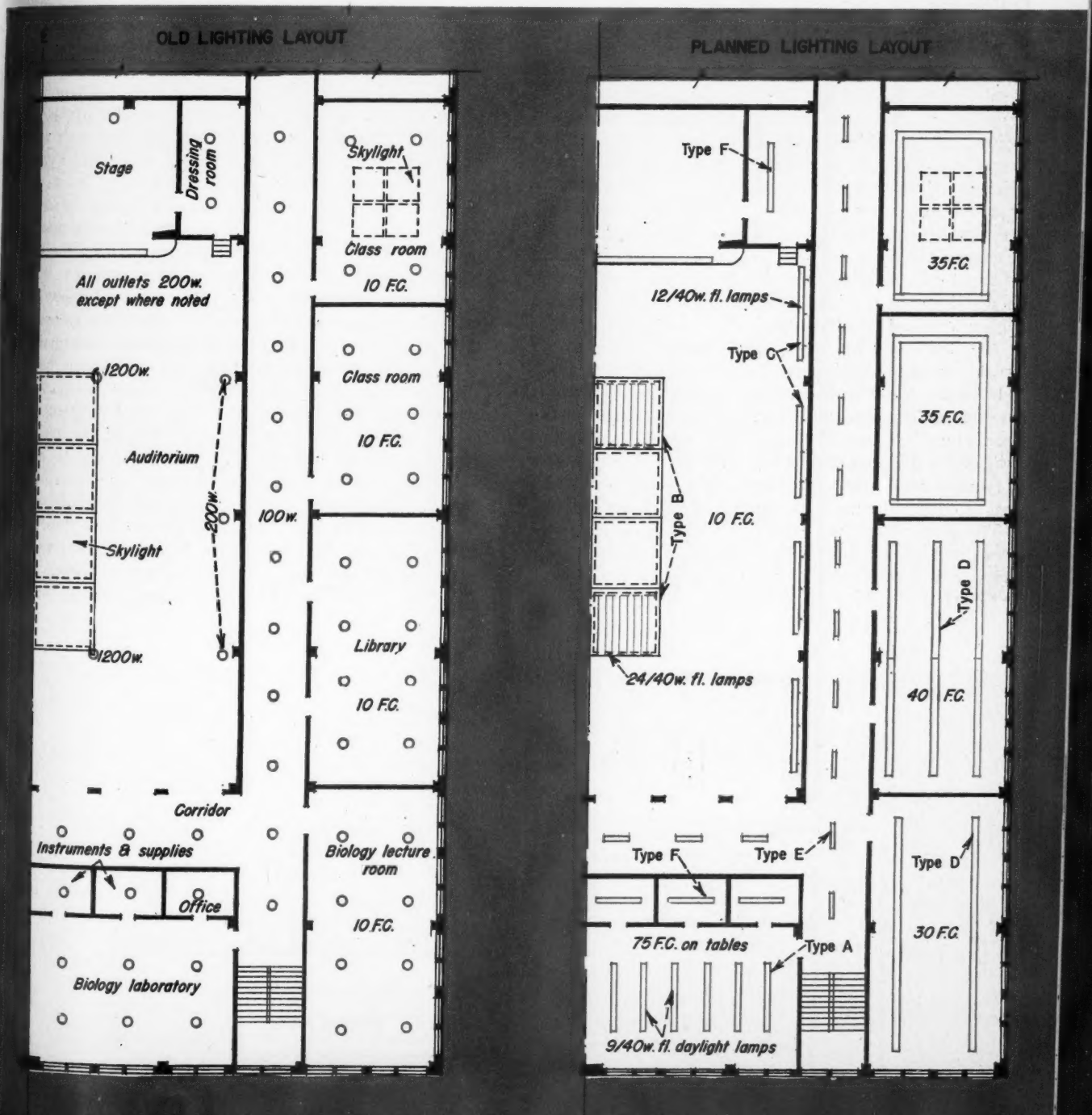
Fixture G is a combination decorative and utility unit. Mounted at the top back portion of the leather settees, it consists of a configurated or etched design glass screen, and a continuous fluorescent light trough below the glass. The glass aids in noise reduction and adds to the decorative treatment.

Fixture H, used to light a mural or large wall photograph, is a recessed ceiling trough with specular reflector to direct the light to the wall area efficiently.

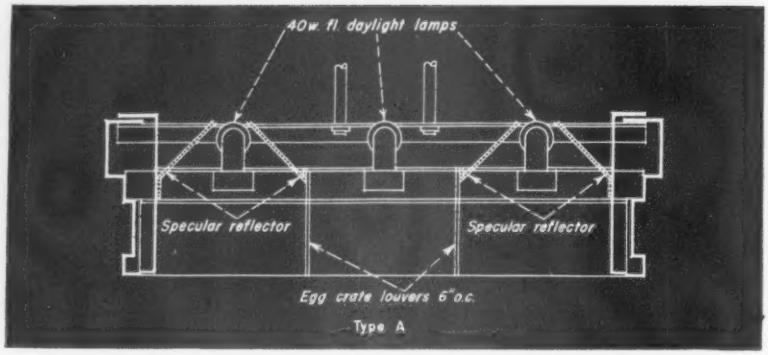
Planned SCHOOL LIGHTING

THIS typical school was built 30 years ago. It served as a grade school until a new Senior High School was built in 1935. It was then changed to a Junior High School, redecorated, and relighted within the limits of the electrical service. Relighting was on a basis of a minimum approach to the lighting standards in the new school. Metal raceway was used to extend branch circuits. Feeders were converted to three wire. Circuits were balanced to make maximum use of the existing wiring. Good quality enclosing globes installed on ceiling fitters, located on approximately twelve foot centers, and equipped with 200 watt lamps, was the best that could be done within these limitations.

This lighting system produced approximately 15 footcandles initially. Due to dirty walls and ceilings, and poor fixture maintenance during the labor shortage, the intensity has depreciated to less than ten footcandles average on the desks. This is double the intensity before modernization, but still inadequate, particularly with all its faults of compromise with recommended lighting practice—



SCHOOL LIGHTING *continued*



uneven distribution, uncomfortable brightness contrasts, and direct and reflected glare.

The electrical contractor may now recommend to this school board a complete modernization of the entire electrical and lighting system in this school, as a community contribution toward postwar reemployment, with special emphasis on light conditioning.

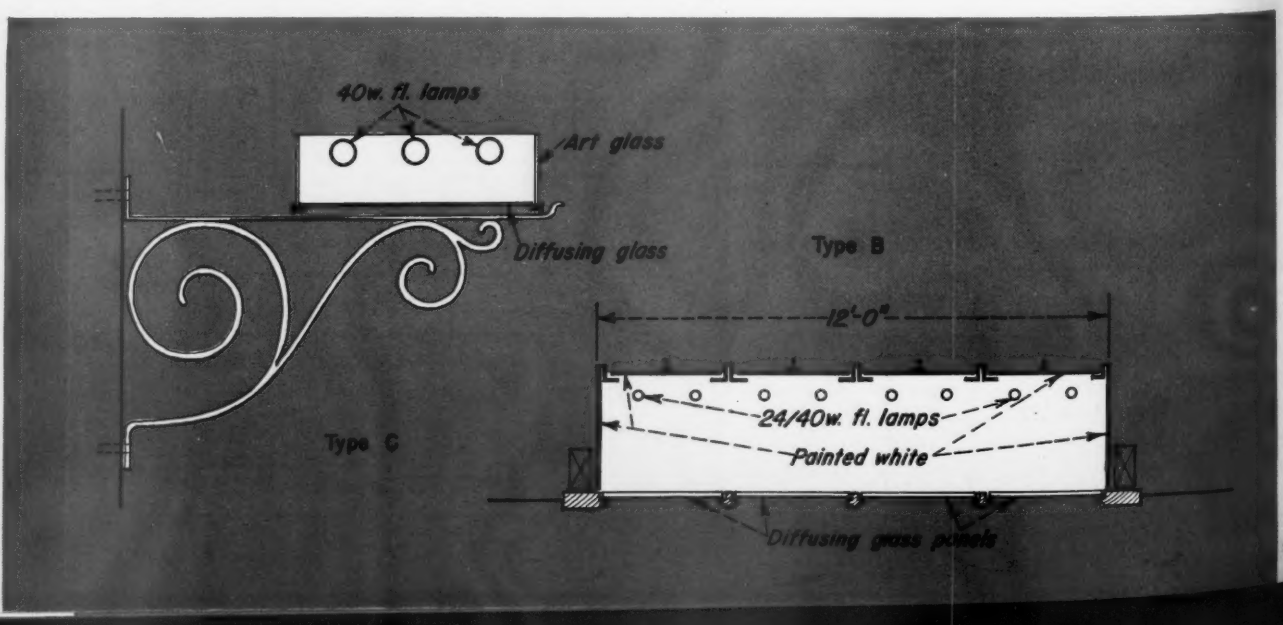
Fortunately, now is the opportune time to plan a school lighting installation that will last for many years without obsolescence. Fluorescent lighting has gone through the "measles, mumps, and chicken pox" stage, and is full grown. Like the skilled mechanic, it is worth the "higher wages" necessary to employ it. It will perform well and efficiently. The new lighting installation should not be based on the meager minima of the 1938 American Standards for School Lighting, as these standards are already obsolete and under study for revision. Instead, it should be based on a lighting level which will encourage study, save and protect eyesight, conserve health, and promote a higher standard of education.

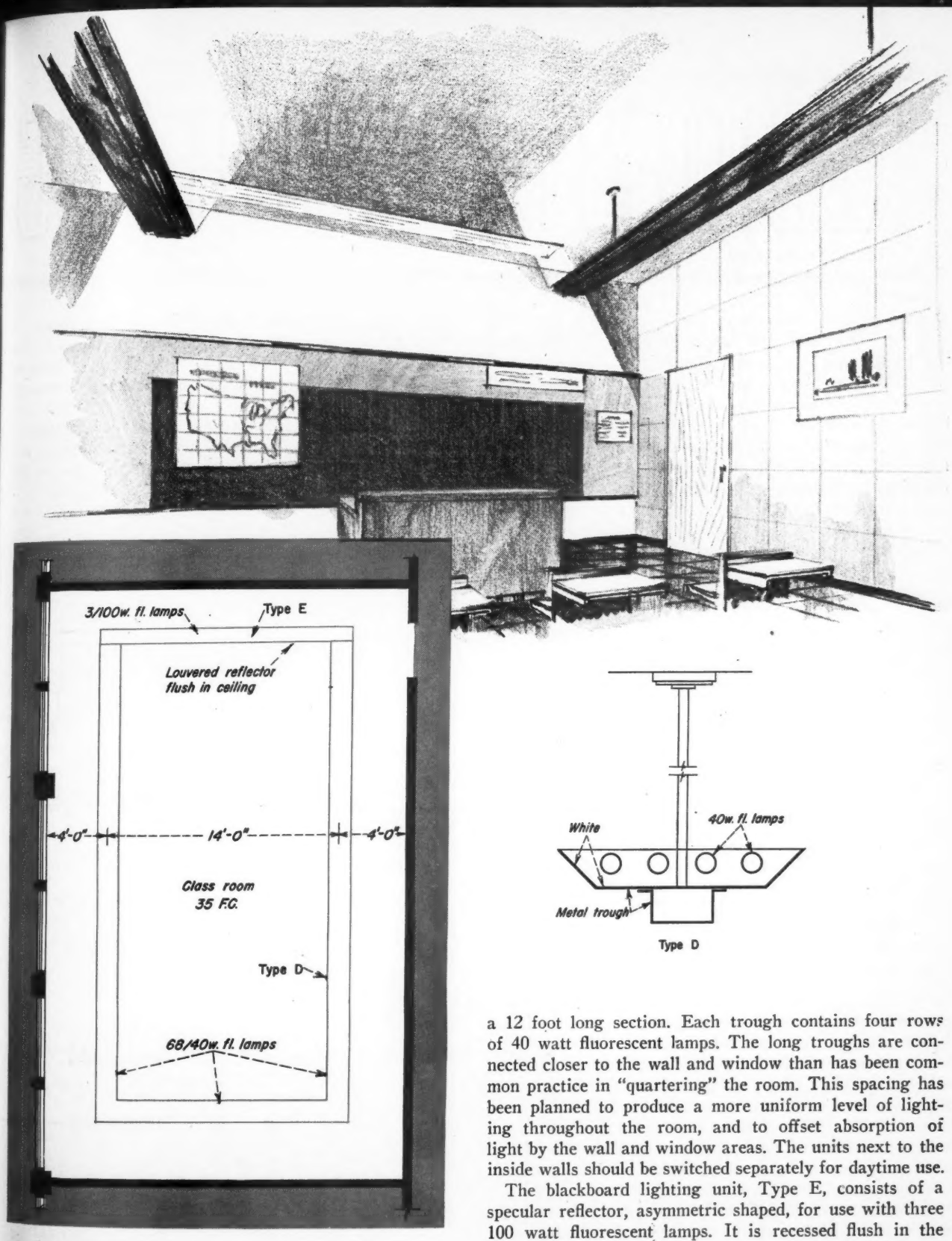
The 1938 standard of quality, indirect lighting for graphic seeing tasks, is acceptable. But it is time to graduate to the 30-40 footcandle level of lighting intensities made possible and practical by "fluorescent." *Sight saving* should now be extended to good eyes as well as defective eyes. With fluorescent lighting, these intensities are now obtainable with approximately the same watts per square foot as covered by the 1938 recommended wiring capacity.

The *planned lighting* layout for this school has been predicated upon fundamental concepts of good lighting practice and consideration for the "eyes of the future." Whereas the lighting standards and quality of illumination have been raised, the system selected is economical. From a community welfare standpoint, can any school board afford not to provide such *planned lighting* for its schools? Available data indicate that older and less efficient lighting installations are perhaps a false economy.

The biology laboratory presents a special lighting problem in color, direction, and intensity of light, to be used for microscopy. Direct light should be provided over each table, from which the surface brightness of the lamp may be reflected by the microscope mirror for transillumination of specimens. It is practical to solve this problem by providing general illumination from the same unit as the necessary direct light. A reflector louver unit, Type A, should be suspended 36 inches above each bench, each unit to be equipped with three rows of 40 watt fluorescent daylight lamps. This type of unit will provide approximately 75 footcandles of proper color quality on the bench top and ten footcandles general illumination.

Since the auditorium is not used for purposes involving critical seeing over long periods of time, ten footcandles of well diffused illumination is considered adequate. A combination of direct-indirect lighting from bracket troughs, Type C, and direct lighting from artificial skylights, Type B, is planned to replace the old direct lighting chandeliers and wall brackets. Four of the art glass panels in the old skylight, each twelve feet square, should be replaced with diffusing glass of high light transmission factor. Above each of these glass panels should be placed a light reflection box containing 24—40 watt fluorescent lamps. Each of these units (see Type B details) may be arranged for cleaning and lamp replacement from above the ceiling. The Type C bracket troughs should each be





Type D

16 feet long, containing three rows of 40 watt fluorescent lamps. The trough should be open at the top, have a diffusing glass in the bottom, and art glass panel sides.

The class room shown in the sketch is typical for this school. It is 22 feet wide by 35 feet long, with a ceiling height of 11 feet. The *planned lighting* for this class room consists of a U-shaped indirect pendant trough and a blackboard lighting trough recessed in the ceiling. The indirect trough, Type D, is 28 feet long on each side of the room, and is connected at the rear of the room with a 12 foot long section. Each trough contains four rows of 40 watt fluorescent lamps. The long troughs are connected closer to the wall and window than has been common practice in "quartering" the room. This spacing has been planned to produce a more uniform level of lighting throughout the room, and to offset absorption of light by the wall and window areas. The units next to the inside walls should be switched separately for daytime use.

The blackboard lighting unit, Type E, consists of a specular reflector, asymmetric shaped, for use with three 100 watt fluorescent lamps. It is recessed flush in the ceiling, and louvered with louvers parallel to light rays to center of the blackboard. It is located away from the wall three feet to light the blackboard effectively.

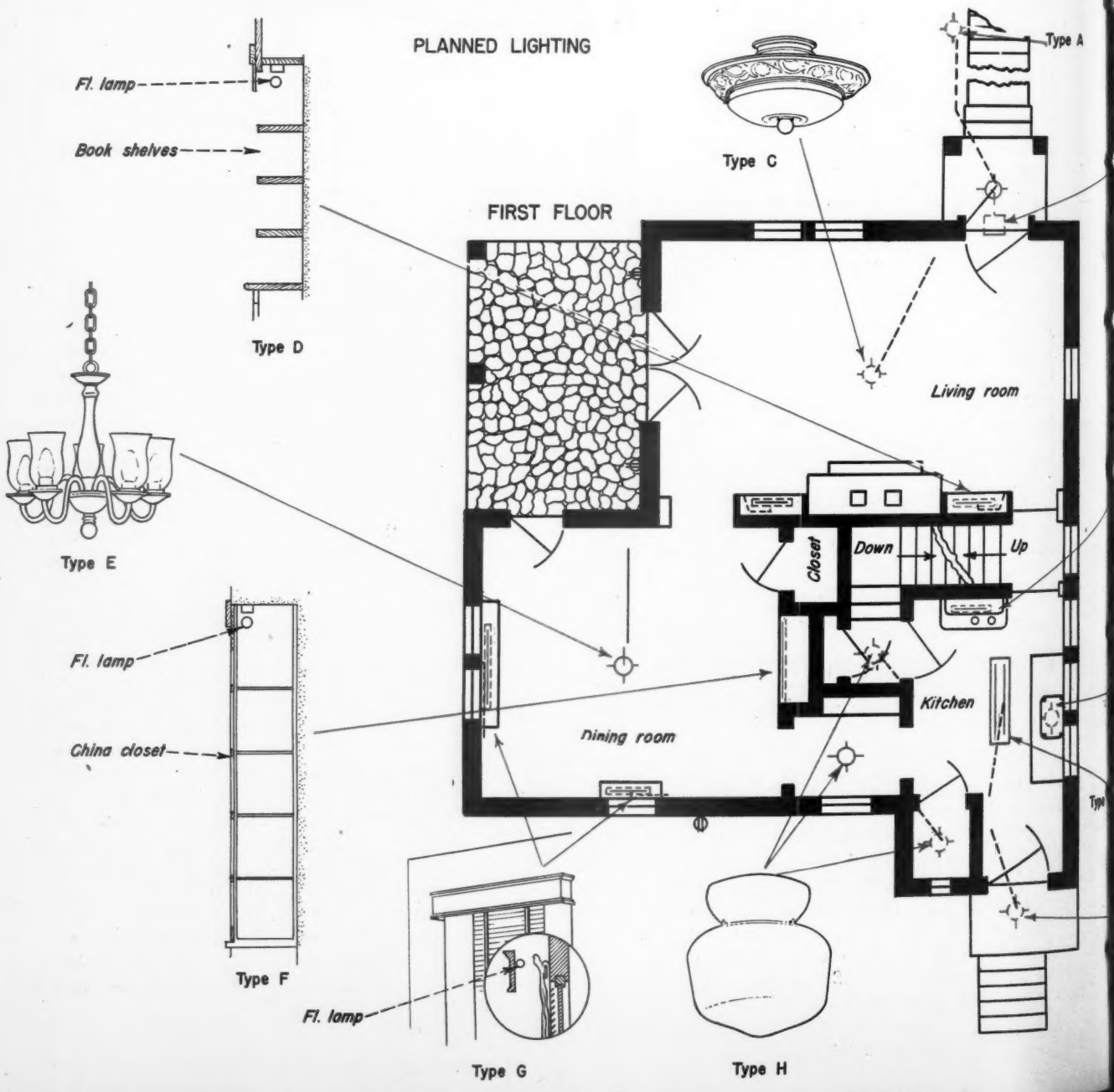
One of the classrooms has a glass panel in the ceiling, with a skylight over it. Because of the glare from the natural light, this is usually more disturbing than helpful. The glass panel should be painted with an opaque white paint to form a reflecting surface, and to eliminate a reflected image of the pendant indirect trough.

In the library and biology lecture room, Type D, continuous troughs are planned to provide a high intensity of indirect lighting only.

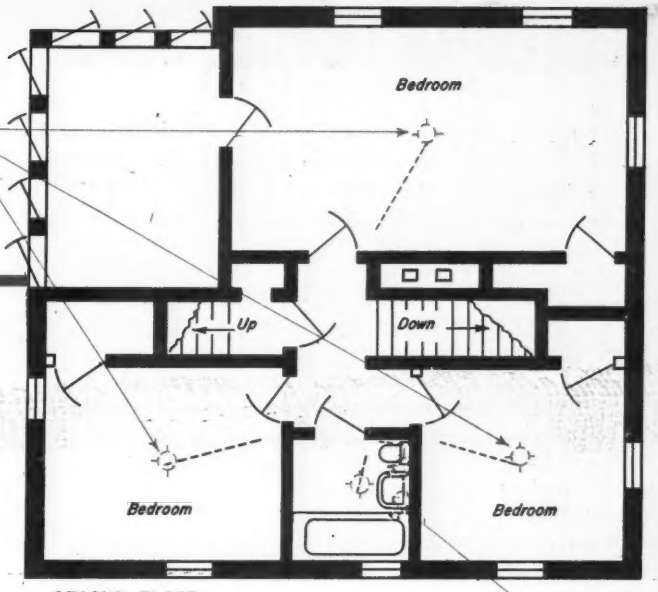
Planned RESIDENTIAL LIGHTING

RELIABLE estimates of the accumulated need for new housing in the nation are almost unbelievable. One recent estimate places this need at over six million homes. Home builders and home owners are now being subjected to a barrage of literature and visualization depicting the possibilities of new lighting devices and lighting techniques. These include slimline, circline, fluorescent, incandescent, ultra-violet, germicidal, infrared, functional and built-in lighting. A very high percentage of the new homes will use some or all of these new products. Each installation made will pyramid the desires of other home owners to follow suit. These desires will expand into the 30 million existing homes. It does not matter greatly how much one chooses to discount the above estimates—it still adds up to a lot of new home construction and modernization of existing homes.

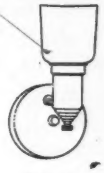
Shown here is a modest house in the median range of cost and number of rooms. The lighting fixtures and wiring now installed in it are typical for houses in this range, which predominates nationally. Planning modernized lighting for it in conformity with the present trend is the type of problem which will confront many contractors for months to come. This house has been



Type N



SECOND FLOOR

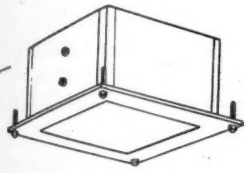


Type O

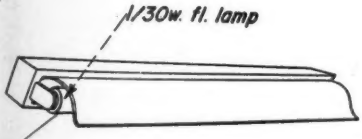
selected purposely, to illustrate how *planned lighting* can be applied logically and economically to the largest potential market. Lighting for new houses, and for the modernization of larger houses, will, no doubt, be handled on a specialized basis.

Starting at the street approach, the first problem encountered is a flight of six unlighted steps. A weatherproof step light (Type A) is installed at one side, properly located to prevent shadows of step risers.

The porch is now lighted with an unshielded glaring light source which casts an objectionable shadow across the steps outside. A recessed panel light (Type B) is installed in the porch ceiling close to the front door, to replace the old light. This location is ideally suited for lighting the visitor so that he may be seen and recognized from inside the doorway.



Type B

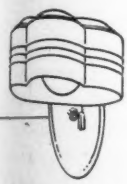


Type K

The living room of this small house is entered directly through the front door. It is adequately lighted with a number of floor and table lamps, when they are all turned on. There is no center ceiling light at present. The need for safety, in entering the room when it is unlighted, dictates the use of a center ceiling fixture (Type C) with wall switch control. This unit, which may be either fluorescent or incandescent, should have all lamps adequately shielded. It is also desirable for use when there is a large group in the room, to supplement the portable lamp lighting and provide illumination.

The living room also offers an opportunity for some built-in bookcase lighting (Type D) on either side of the fireplace. Such treatment serves a double purpose. It adds color, depth, and interest to the room, and provides useful light for selecting books, or displaying art objects and miscellaneous souvenirs. A fluorescent lamp of appropriate color to harmonize with room decorations, concealed by a narrow plywood valance, provides an excellent light source for this use.

The dining room features a built-in china closet which, under the usual room lighting, is dark and uninteresting. By replacing the wood shelves with plate glass, and adding a fluorescent lamp (Type F) of proper length across the top, fully concealed by a valance, the whole cabinet is lighted. Similar fluorescent lamps are installed over each of the two windows (Type G) and concealed behind valance boards. Here the light is permitted to spread out on the ceiling above, creating a comfortable indirect lighting effect. It also spills downward on the window shades and drapes, creating a colorful decorative effect. When dining by candlelight is in order, light from the china closet and window valances furnishes adequate illumination to placate the usual male aversion to this purely feminine idea.



Type L

Existing outlets and switches shown only where pertinent to alterations

Existing lighting outlet
Existing switch leg
Proposed switch leg
New lighting outlet

Type M

RESIDENTIAL LIGHTING *continued*

Except for special occasions when candlelight is used, a central ceiling fixture (Type E) provides light adequately and economically for dining. A dual light source suspended unit is preferable, one in which one light source only is used to light the table for dining, and separate light sources are used to provide indirect lighting for general room illumination. Crystal chandeliers are still in demand for dining rooms, and represent a consumer preference. When used, however, lamps should be of low wattage so that these chandeliers are primarily decorative. Useful illumination should be obtained from other sources, as is done when candles are used.

The kitchen is small, compact and modern in layout. It is lighted by one fluorescent kitchen adapter unit equipped with two 20 watt lamps. This unit has replaced a 100 watt incandescent glass enclosed ceiling fixture installed when the house was new, on the assumption it would produce "twice the amount of light at half the current cost". The home owner has already learned that the amount of light obtained from this fluorescent unit is approximately the same as with the former incandescent unit. It does not provide enough light, and there are still shadows at the sink, range, and work counters. A longer fixture (Type J) with two 40 watt fluorescent lamps produces more light, and softens shadows. In order to make work easier in the kitchen, however, and to promote cleanliness, the housewife also insists on a light over the range (Type K installed under a cabinet), and over the sink (Type L). The unit over the sink is mounted on the window mullion between two windows. A flush type fluorescent or incandescent unit recessed in the ceiling over the sink would achieve the same result.

Safety and good housekeeping dictated the installation of a ceiling light (Type H) above the cellar stair landing, in the pantry, and in the passage between the dining room and kitchen.

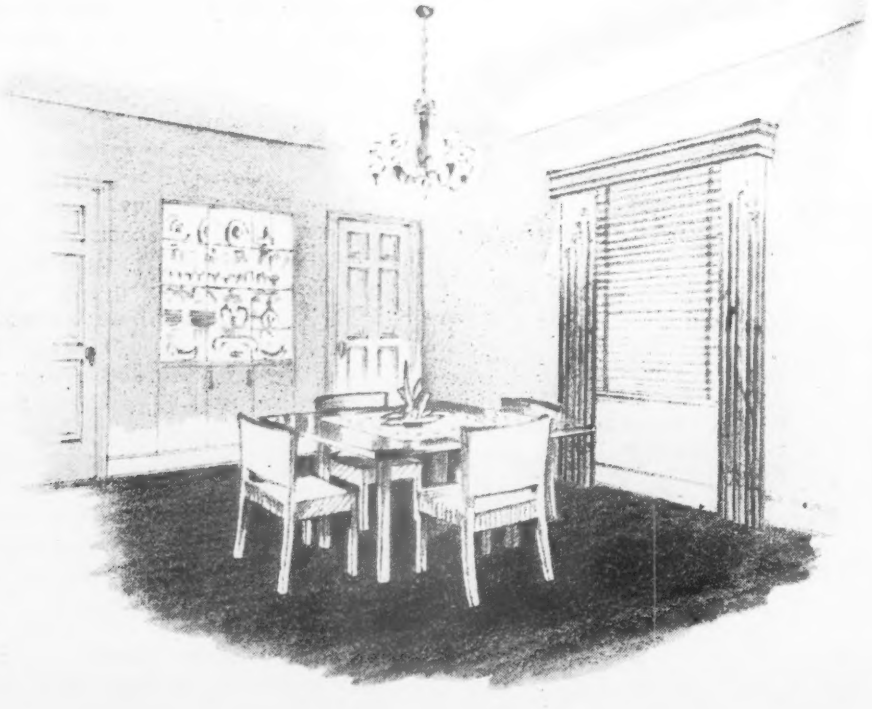
The rear entrance, by way of the kitchen, is unlighted. The added convenience and safety afforded by light at this point justifies the installation of a shallow metal reflector (Type M) flush in the ceiling of the entrance canopy. Where canopies do not exist, a suitable weatherproof bracket may be installed over, or on one side of the rear door.

On the second floor, the three bedrooms are now lighted with portable floor, table, and vanity table lamps. The ceilings are devoid of fixtures. Ceiling units (Type N) using either incandescent or fluorescent lamps, with wall switch control, are therefore installed for added convenience and improved distribution of light.

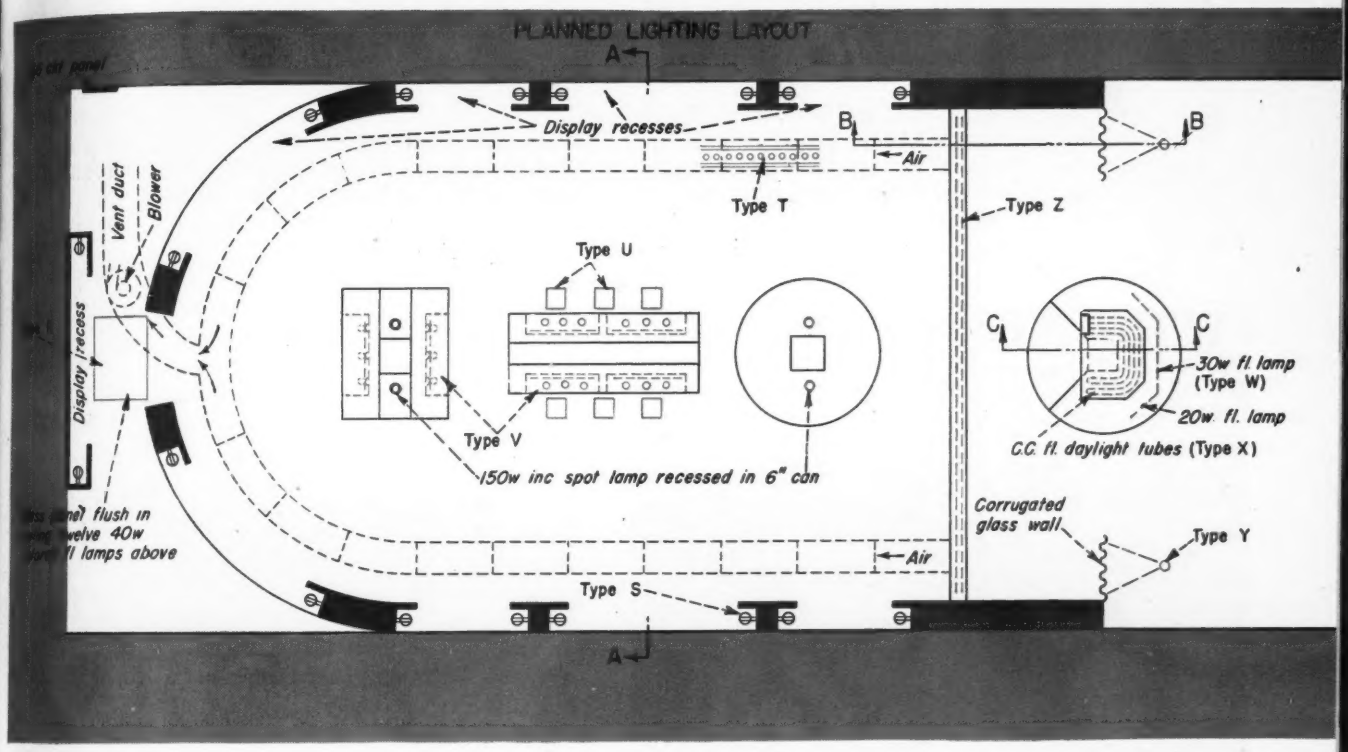
The bathroom is now lighted by a single 20 watt fluorescent lamp installed above the mirror. The height of this unit above the face results in shadows under the chin, and there is not enough light. Twin brackets (Type O), one on each side of the mirror at a more appropriate height from the floor, are used to replace the single unit. These may be incandescent or fluorescent types, with the lamps shielded to reduce surface brightness. A center ceiling outlet is also installed, to which is attached a shielded fluorescent lighting unit equipped with two 20 watt fluorescent lamps.

The *planned lighting* changes have added a great deal to this home in safety, convenience, eyesight protection and decoration. But the home owner, now accustomed to high level *planned lighting* in industry, offices and stores, is unwilling to do with less in his home. There are still an infinite number of lighting devices which have not been included in this modest home which will find a ready acceptance in many homes. A partial list includes:

Germicidal lamps for kitchen and nursery
Outside floodlights for garden and play areas
Illuminated house numbers for front entrance
Fluorescent lighting for the home workshop
Fluorescent lighting for home laundry
Night lights for bedrooms, halls and stairs.



Planned STORE LIGHTING



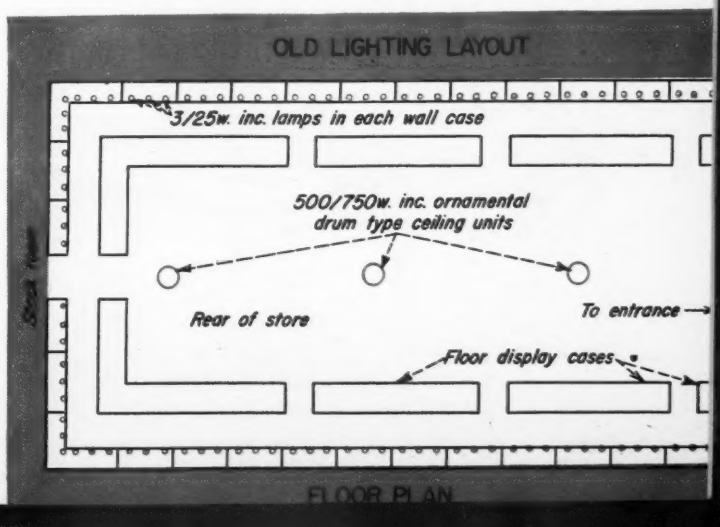
THIS women's specialty store might be considered by many as fairly well lighted now, with better than average wiring. Critical analysis, however, will reveal a fallacy in such consideration.

General lighting, as shown in the old lighting layout below, is from attractive ornamental type luminaires located on 15 foot centers down the center of the store. Each luminaire is normally equipped with a 500 watt lamp, which is replaced by a 750 watt lamp for the Christmas and Easter seasons. These luminaires are 18 inches in diameter, and are mounted high to spread the light effectively and reduce glare. Wall cases are lighted with standard reflector equipment for use with 25 watt tubular incandescent lamps, properly concealed from view.

Electrical contractors having a full appreciation of proper lighting results, and good color quality in a lighting system, will be quick to find the flaws in this store's present lighting. They will note that the customer casts a shadow on the nearest show case. They will also note that the overhead lamp wattage is too low, that the luminaires are too small, thus causing some glare, and are incapable of taking the size lamp really needed. The show case lighting is decidedly yellow, or "off color," because the lamps used are of small wattage, operating at low lumens per watt output. Floor, wall, and ceiling colors are fairly effective in reflecting light, but lighter colors would improve the lighting efficiency, and general appearance. Upon further investigation, it will be found that there now exists one hundred lighting outlets in this 100-foot deep store. The average watts per square foot of floor area is normally three, which is increased to three and one-half for holiday buying. It will finally be decided that the greatest fault with this lighting system is that *the brightest thing one sees upon entering this store is not merchandise, but lighting fixtures.*

If the electrical contractor is willing to make a detailed study of the possibilities for modernization of this store, he will find that *planned lighting* offers an outstanding medium for creating individual distinctiveness, which will pay continuing dividends to the owner. One such study is presented here, covering the rear half of the store only. Here is what this area might look like to a customer seeing it for the first time, if these modernization plans were carried out.

The ceiling at the front of this portion of the store is



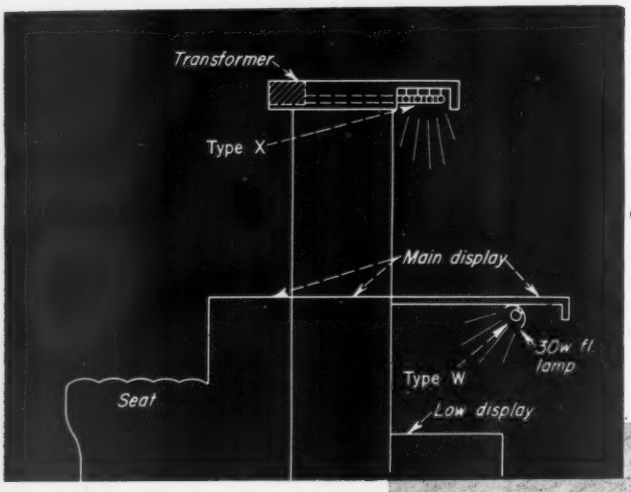
STORE LIGHTING *continued*

flooded in a welcome (warm white) glow, produced by two lines of fluorescent tubing in an indirect cove (Type Z). The first impression is pleasant. Not a light is visible, but things for sale are easily seen. Two bright displays flank the entrance. These are full size models highlighted from hidden spotlights (Type V) recessed in the ceiling, which stand out against a background of corrugated glass extending out from each side wall.

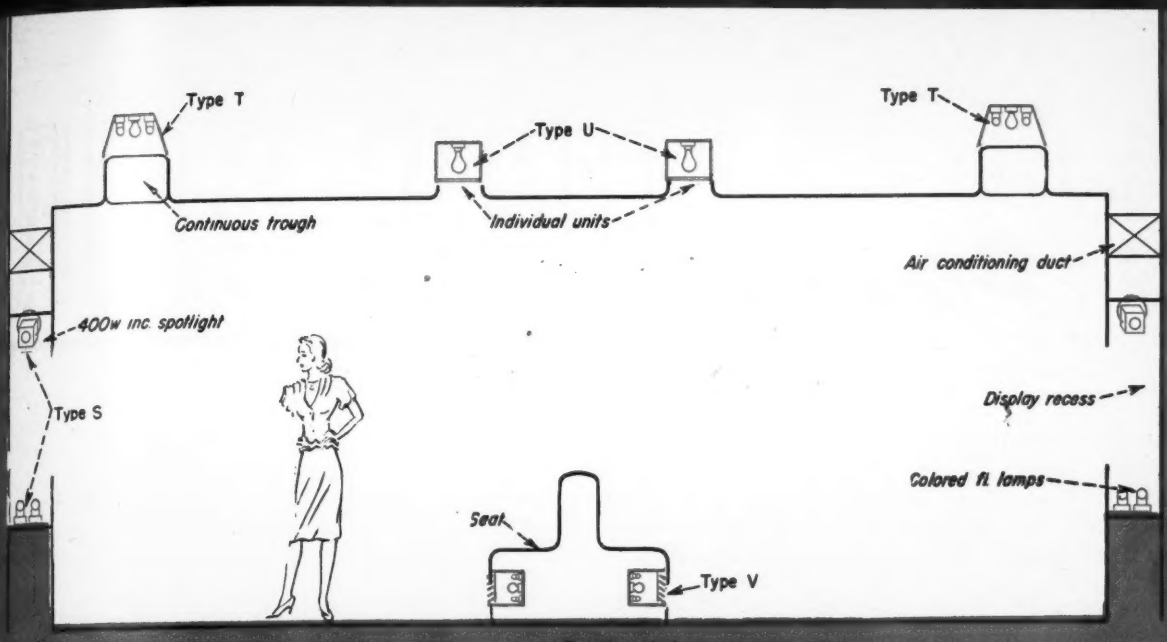
In the center is a brilliant counter display. On a lower shelf of this display, concealed fluorescent lamps (Type W) light bulky merchandise, while on the main display table bright light is reflected down from curved fluorescent tubes (Type X) hidden in a mirrored canopy just above eye level. Peering up, four lines of bent 15 millimeter tubing would be seen. This tubing is operated at 60 milliamperes, and produces color corrected daylight.

The next counter, as well as the rear center display stand, is illuminated by 150 watt type R-40 reflector spot lamps set well up out of sight above the ceiling, in a six-inch diameter metal housing. One circuit is used for these four spotlights, since 300-watt lamps may be used at a later date. Near the center of the ceiling a pattern of six lights (Type U) is recessed in the ceiling above a bench where customers sit. Each light uses a concentrating type glass lens, with a 150-watt daylight lamp mounted in a metal housing with suitable reflector above the lens. The complete assembly is recessed four inches above the ceiling line to provide desired shielding of the glass lens from view.

Of special interest are the footlights (Type V) used to light shoes being tried on. These footlights are located beneath the seats and in the rear display stand, near the floor. Each footlight is a recessed metal box which contains standard fluorescent lamps and small incandescent lamps. These lamps are concealed in the box behind a hinged diffusing glass and louvers, to prevent the light from reflecting upwards. The cold light of fluorescent lamps is blended with the warmer tints of the incandescent lamps. This produces a beautifully color-balanced light, adjustable as to blend by the store manager by the simple procedure of installing incandescent lamps of larger or smaller size until the exact color quality desired is obtained. Many customer complaints and much loss from

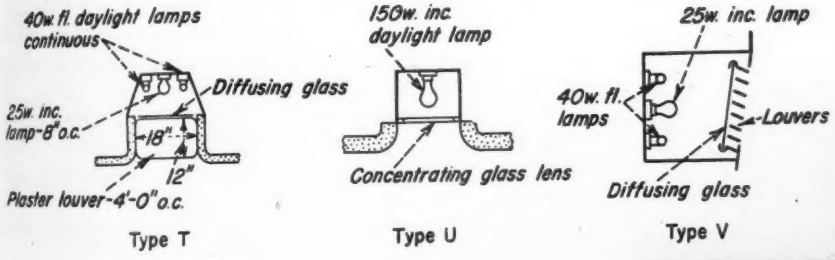


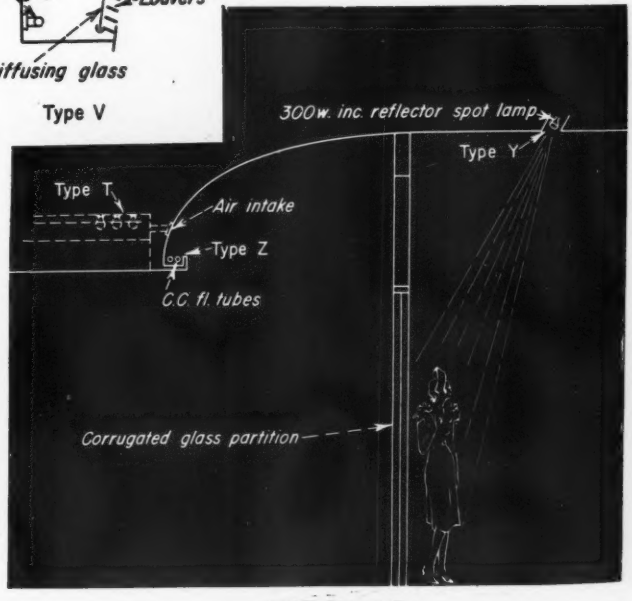
SECTION C-C



Section A-A

LIGHTING UNIT DETAILS





SECTION B-B

returned merchandise can be avoided by use of such a blending procedure to provide proper color quality of lighting for viewing merchandise where color tones are involved.

The most dramatic feature of this *planned lighting* layout is the display niches recessed in the walls. Each niche (Type S) is flooded with rich color from fluorescent tubes set back from the line of view, and the feature display is brilliantly highlighted by a 400-watt lens spotlight. The accurately controlled beam appears to be actually visible against the colored background.

An unusual device is the "atmospheric" lighting unit. Just outside the door to the stockroom at the rear, a light box (Type R) is installed ten feet above the floor. The metal box is 36 inches wide and 48 inches long, and is wired for twelve 40-watt colored fluorescent lamps. This unit reflects through its glass lower surface a flood of cool light in summer, and by a change of lamps, warm tinted light in winter.

A striking feature of the lighting system is the great recessed horseshoe (Type T), 86 feet from one tip to the other. The three major requirements of desirable store lighting are met here:

(1) All light sources are concealed.

(2) Light sources are blended for correct color quality.

(3) Light is directed to the merchandise and not into the customer's eyes.

Incandescent and fluorescent light is perfectly blended in the Type T unit. A white enamelled reflector directs daylight quality illumination from fluorescent daylight lamps, and warm orange quality illumination from small incandescent lamps, down through carefully selected diffusing glass, past plaster louvers, and into the room below. This creates the feeling with store customers that they are making their purchases in a store which obtains its illumination from the sky. Selection of merchandise is thus speeded, and customer confidence is increased.

Fluorescent lamps operate most efficiently at normal room temperature. Lamps lose up to ten percent due to heat rise in an open reflector, and more in a closed reflector. In the Type T light trough, continuous air flow through the trough has been designed to remove heat and maintain high lighting efficiency.

Planned DRUG STORE

IN today's competition for the buyer's dollar, the traditional pharmacy has been expanded into a virtual department store. Its diversified wares seem to be limited only by the space available for stock and display. This transition has, of course, been gradual. Perhaps that is why it is still called a "drug store".

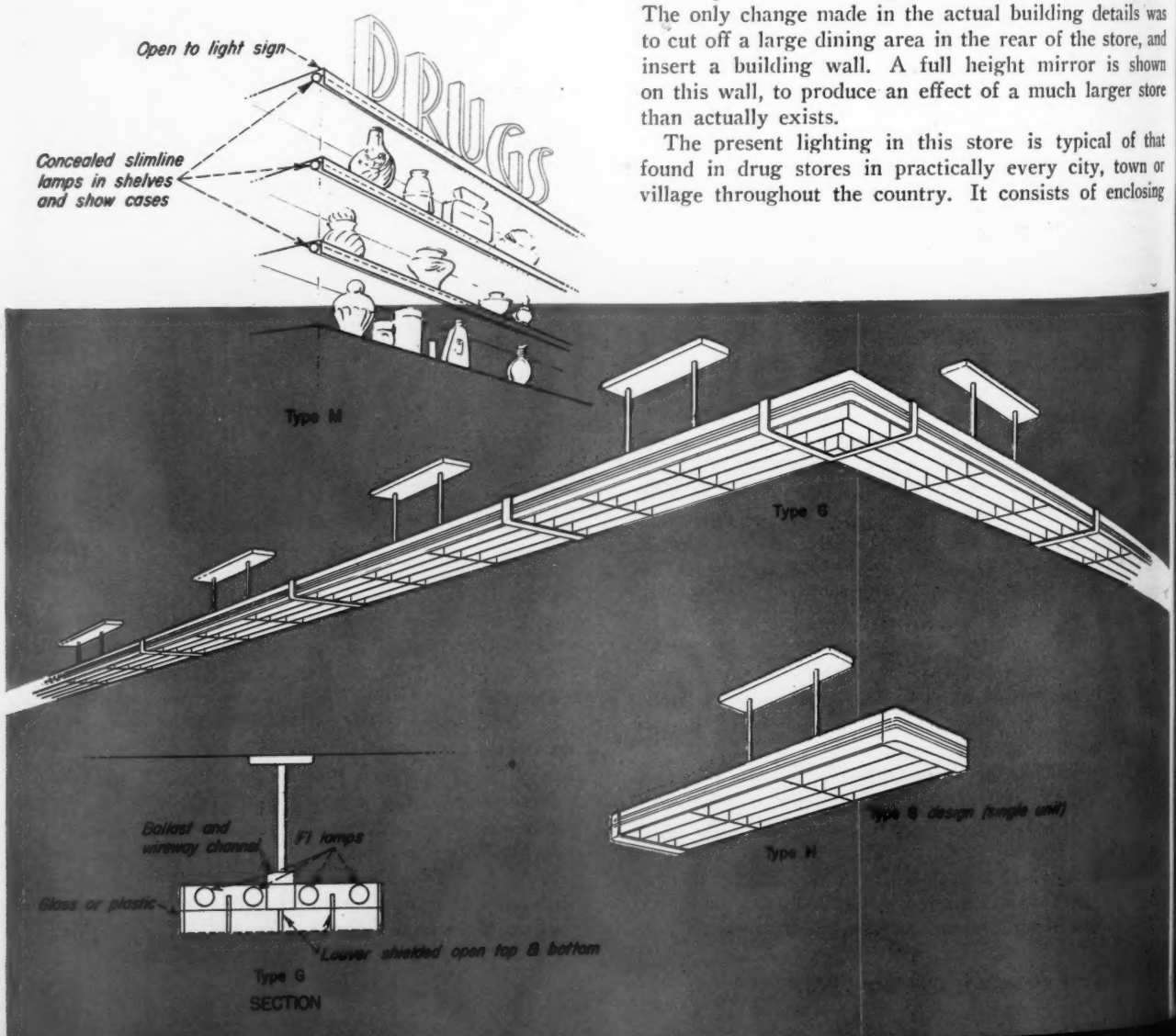
There are many factors which should be given consideration when planning drug store lighting. The size of the store, and the diversification of areas, will influence the number of factors involved. For example, types of merchandise displayed vary in size, shape, color and packaging. Products range from drugs, patent medicines, dental and health accessories, to cigarettes, tobacco, stationery and books, fountain pens, ink, household and personal accessories. There is usually a separate cosmetic counter, often a candy counter, and even a prescription department. Most drug stores have a soda fountain. Food is generally served at the fountain, and in some cases a separate dining section is provided.

Such combinations of displays, areas and departments, generally within the same unpartitioned space, call for equally diversified functional lighting. High levels of illumination, discriminately controlled and directed, and of proper color quality, are needed. It should be properly designed to *sell,* and not to compete with, the merchandise displayed.

All light sources should be concealed or carefully shielded. Lighting equipment should be as inconspicuous as possible, so that the attention of prospective buyers is not attracted away from display counters. When the lighting equipment is suspended from the ceiling, some form of continuity is desirable. It should also provide even distribution and low surface brightness. Many individual lighting units hanging from the ceiling cause confusion and look too spotty, in a store already abundantly stocked with salable goods.

The plans for the drug store used here are authentic. The only change made in the actual building details was to cut off a large dining area in the rear of the store, and insert a building wall. A full height mirror is shown on this wall, to produce an effect of a much larger store than actually exists.

The present lighting in this store is typical of that found in drug stores in practically every city, town or village throughout the country. It consists of enclosing



LIGHTING

glass globes suspended on a chain, and equipped with 200 watt lamps. These are spaced on approximately twelve foot centers. Open reflectors are used over the fountain area, spaced too far apart for adequate lighting, and are unshielded. The lighting is of the same color quality throughout the store, and the general level of illumination is very low, less than ten footcandles average.

To the electrical contractor or lighting salesman measuring lighting jobs in terms of footcandles only, and looking for a quick sale, it might be considered that the solution for this store's lighting problem is to replace the present 200 watt incandescent fixtures with an ornamental four-lamp 40 watt fluorescent suspended luminaire. The footcandle intensity would be doubled, it might be correctly argued, and all at no increased cost in the light bill.

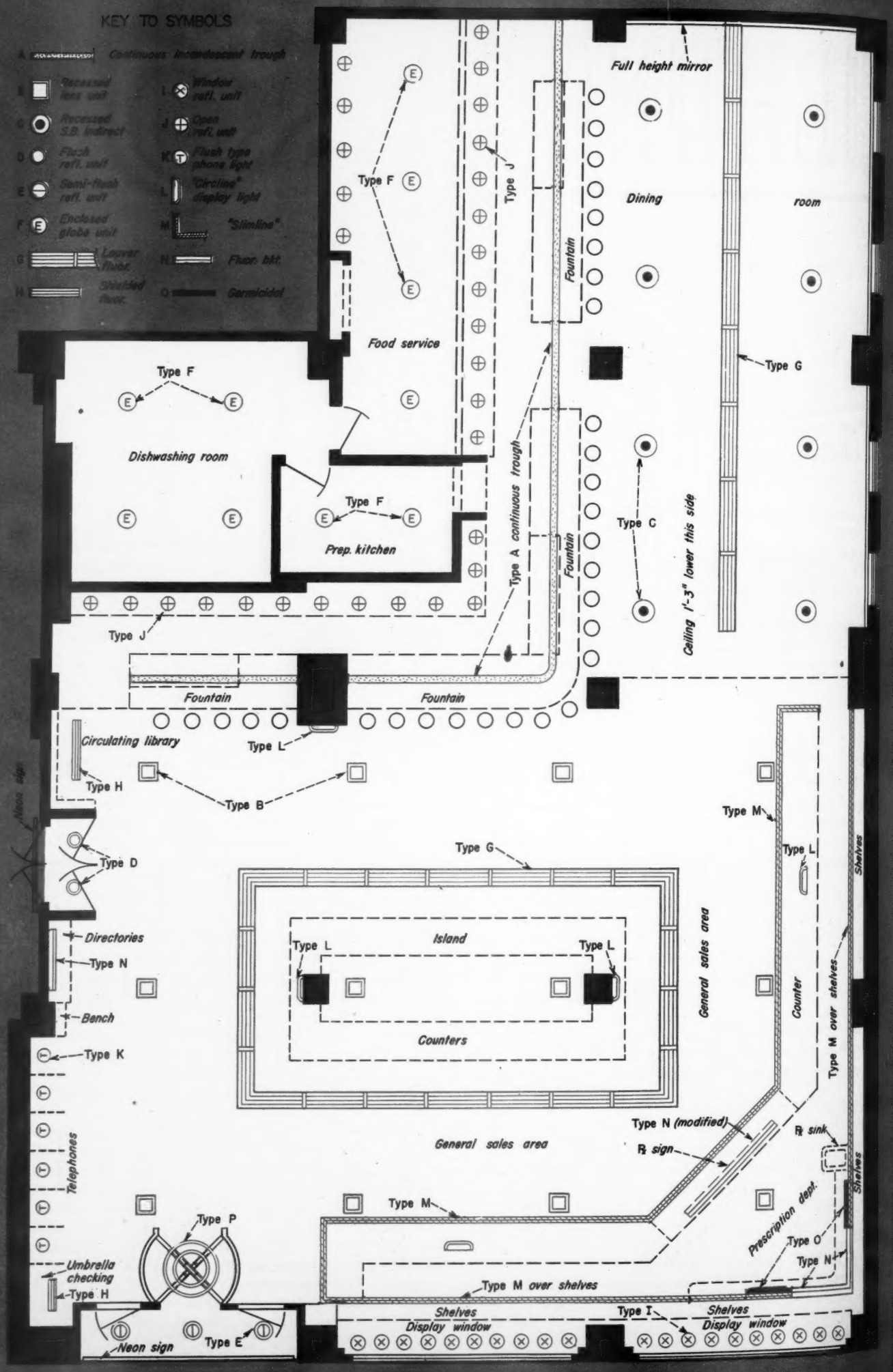
Why wouldn't such an installation be adequate? What is wrong with this solution? A careful analysis of the *planned lighting* design for this store, presented here in detail, will give the best answer to these questions. And the progressive drug merchant will instantly recognize the added sales value of lighting, such as has been planned for the diversified lighting problems presented by this store.

The *planned lighting* incorporated in this layout has been carefully considered for each area. The following criteria were established, and met, for the solution of each lighting problem.

1. Attain highest levels of illumination consistent with varied requirements of types of merchandise displayed, and with customer comfort.
2. Use available types of lighting equipment and components.
3. Achieve economy of installation, operation and maintenance.
4. Create contemporary styling that is not dated; combine simplicity and custom appearance. This is usually possible through limited use of applied color or finish, matching walls, ceiling or furniture, to gain architectural unity with the interior.

On the assumption that this *planned lighting* layout is installed, the following description would obtain.

Street traffic is attracted to this store by a large neon sign over the main entrance, and by two brilliantly lighted, wide, shallow type show windows. Floor space, always at a premium in a store, has been conserved by keeping the show windows shallow. Concentrating type prismatic or silver-mirrored glass reflectors (Type I), equipped with 200 watt incandescent lamps, and installed 12 inches on centers, light these shallow windows evenly from top to bottom with an attracting-power intensity. By installing the reflectors flush in the ceiling, the transparent painted sign at the top of the plate glass is also evenly lighted. Since the back of the windows is closed, no louver equipment is necessary, but color frames are provided for variety in display effects.


KEY TO SYMBOLS
A Continuous incandescent trough
B Recessed lens unit
C Recessed S.B. indirect
D Flush refl. unit
E Semi-flush refl. unit
F Enclosed globe unit
G Louver fluor.
H Shielded fluor.
I Window refl. unit
J Open refl. unit
K Flush type phone light
L "Circline" display light
M "Slimline"
N Fluor. blt.
O Germicidal
Full height mirror
Type F
Type J
Dining
room
Fountain
Food service
Type G
Dishwashing room
Type F
Type A continuous trough
Fountain
Type C
Ceiling 1'-3" lower this side
Type F
Prep. kitchen
Type J
Fountain
Fountain
Circulating library
Type L
Type H
Type B
Neon sign
Type M
Type L
Shelves
Type D
Type G
Island
Type L
Type L
General sales area
Counter
Type M over shelves
Directories
Type N
Counters
Bench
Type K
Type N (modified)
R. sink
R. sign
General sales area
Telephones
Type M
Prescription dept.
Type P
Type O
Type N
Umbrella checking
Type H
Type M over shelves
Shelves
Display window
Type I
Shelves
Display window
Neon sign
Type E

Three shallow glass bowls, each in a semi-recessed unit (Type E), equipped with a 75 watt incandescent lamp, are installed over the exterior of the main entrance. The warm glow from these units presents an invitation to enter the store.

Over the revolving door is located a flush circular lighting unit (Type P), which provides light within each quarter of the door at all angles. The side door, providing entrance from a building lobby, is lighted with two round flush ceiling units.

Inside these two entrance doors is the general sales area. General illumination is provided by two types of units. Square lens units (Type B) are recessed flush in the ceiling on symmetrical spacings, thus providing an even general illumination throughout. One 200 watt incandescent lamp is used in each unit. High efficiency and accurate light control results. The color quality of the resultant illumination is fairly white, but tinged with some yellow and red radiation, typical of light from incandescent lamps.

The other type of lighting unit used for general illumination in the sales area is a suspended continuous wafer-like fixture (Type G), planned on a rectangular perimeter, and framing the island counters. This unit spreads light from fluorescent lamps to the ceiling, softening the surface contrast with the recessed lens units. It also spills light downward through louvers, and provides accent lighting on the counters. The new 4500° white fluorescent lamps are used in this fixture. These lamps produce a blue white light, but not as blue in color, or as cold in appearance, as the 6500° blue daylight lamps.

Blending of the incandescent and fluorescent light produces a spectral color quality illumination ideal for displaying all types and colors of merchandise sold in this area. Selection of lipstick and rouge colors, powder, nail polishes, and all types of merchandise in which color is a factor, is simplified and speeded up. Returns on merchandise due to dissatisfaction of color are entirely eliminated. Expensive cosmetic and specialty sale packaging, in which color is a dominant feature, show up in their true color, and increased sales are sure to result.

Wall display shelves and floor counters adjoining wall areas are highlighted by concealed fluorescent slimline lamps (Type M), available in different colors to meet the whims of the store's display manager. Usually, 3500° white lamps are most satisfactory for this application. Departmental signs over shelves, using solid letters in silhouette, or translucent plastic letters, are effectively illuminated from the fluorescent lamps used for lighting the shelves.

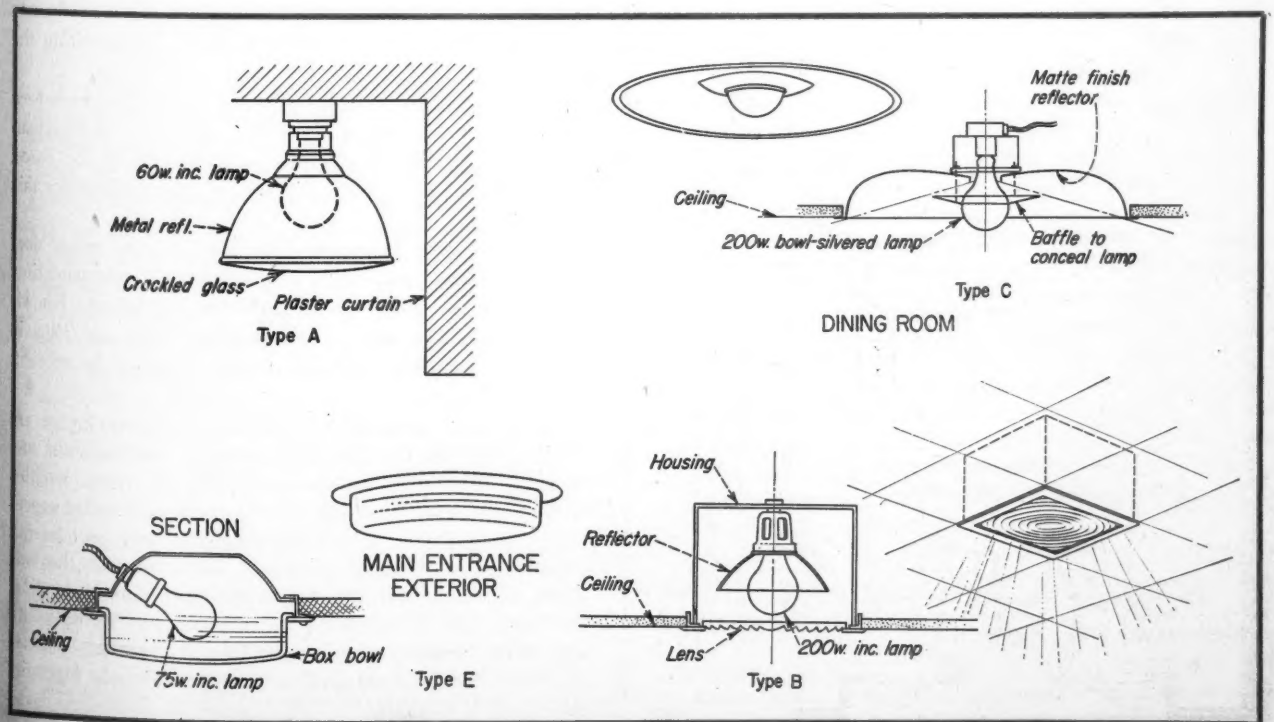
Fluorescent brackets (Type N) illuminate the prescription work area, and adequately shield and conceal the lamps. Two germicidal lamp brackets (Type O) are installed above eye-level in the prescription department, readily visible to customers. These units might logically be properly labelled as such, to promote consumer confidence.

Additional light is supplied over the prescription counter by a fluorescent unit (Type N modified) over which is also incorporated a luminous sign reading "Prescriptions". The bottom of this unit is equipped with a glass concentrating type lens, and light is furnished to the plastic letters above from the fluorescent lamps within the housing through a top opening.

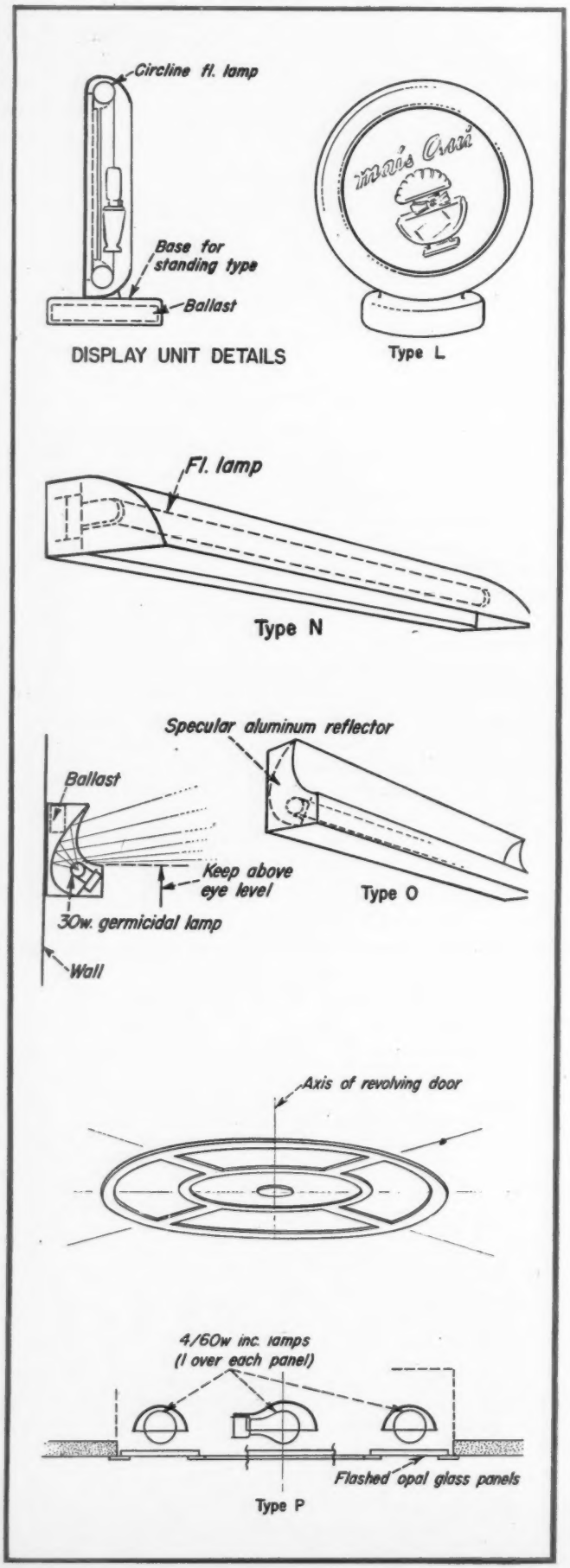
The umbrella checking corner, and the circulating library area are lighted with individual fluorescent units (Type H), which conform in design and finish with the central rectangular fluorescent unit. Telephone booths are lighted with the typical flush type incandescent ceiling units (Type K).

Several unique display units (Type L) are judiciously placed on counters, and on columns or otherwise narrow, unusable spaces. These units consist of a concealed circline lamp, surrounding a display area in which may be placed featured products. They serve the double purpose of accenting merchandise, and of adding a colorful decorative touch.

In the dining room general illumination is provided by eight flush type incandescent units (Type C), each equipped with a 200 watt bowl-silvered lamp. These



DRUG STORE LIGHTING *continued*



are open reflector type units, with a white matte finished reflector for complete diffusion. Metal baffles completely shield the neck of the lamps. Here also, a suspended continuous wafer-like fixture (Type G) is used, in this instance on a linear plan, to distribute light over the ceiling, and to spill some light downward. This fixture is in harmony with the general sales area fixture, and this treatment attains architectural unity for the entire store. Soft white fluorescent lamps are used in the Type A fixture in the dining room. This light, combined with the reflected incandescent light, creates an ideal color quality of illumination for viewing food, and attains a more intimate atmosphere for dining.

The fountain counter is lighted with a continuous trough of reflectors (Type A) equipped with 60 watt incandescent lamps. This trough and the reflectors are concealed behind a plaster curtain. Adequate light is reflected down to suggest cleanliness, and the incandescent lamps make foods in preparation and service look more appetizing.

Work rooms and service counters and areas, are lighted with conventional proven units (Types F and J) to present-day recommended levels of illumination. These units are adequately shielded, and easy to maintain.

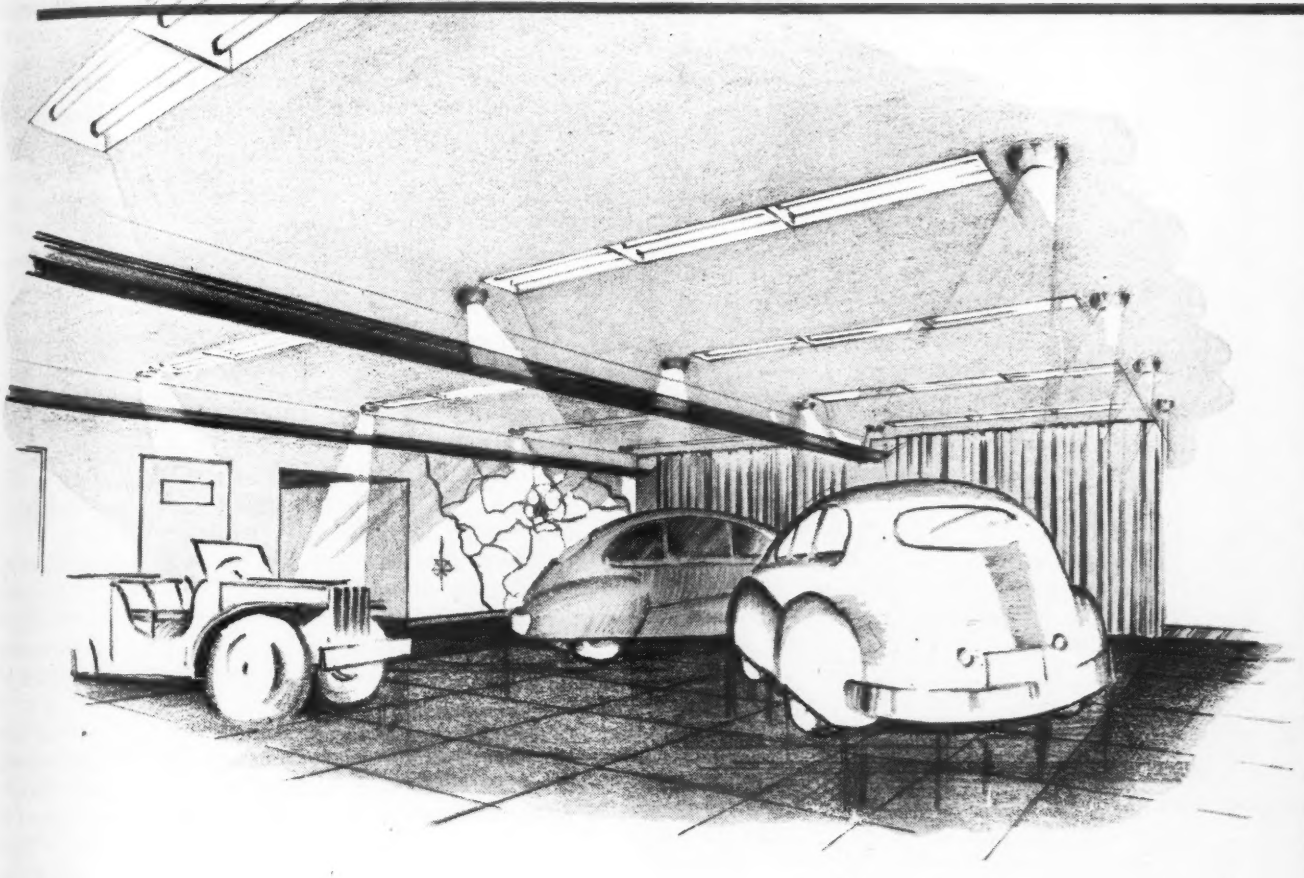
Additional equipment, not shown in this layout, might well have been included. For example, adjustable spotlights might have been incorporated in the corner sections of the Type G suspended fluorescent lighting fixture used in the general sales area. Spotlights would be useful in accenting floor displays, or feature displays located on the island counters, with a high intensity of white light. Reflector spot lamps are ideal for this application. They should be concealed, when used, so that the bottom of the spotlight is recessed within the lower surface of the fixture. High intensity spotlights, provided with color frames, could also be used in the front display windows, for unusual window lighting results. Germicidal units (Type O) might also be located on the wall behind the fountain, installed at least six feet six inches above the floor to prevent direct vision of the germicidal lamps within the reflector.

Display case lighting (Type M) might also have been provided for the island counters. The type of merchandise displayed in these cases, and on top of the cases, governs to a large extent the use of case lighting for this location.

The contractor's responsibility to the store owner does not, of course, end with the lighting recommendation. He must also include an adequate wiring layout. Knowledge of paints, colors, and finishes, will also help in achieving an ideal *lighting result*, planned for efficient light utilization.

Techniques used in this *planned lighting* layout are flexible, and easily adapted to smaller stores. Units and components shown are made in various types, lengths, widths and sizes, and are for the most part easily assembled. Drug stores will be among the first to take full advantage of lighting progress made through the war years. Blackout and dimout experiences notwithstanding, the consumer is becoming fully conscious of the health and esthetic values of advanced lighting practice—*planned lighting*. He demands and expects it. American ingenuity has made it available.

Planned SHOW ROOM LIGHTING



IN these early postwar months and for some time to come, we are told, automobiles will be bought, and will not have to be sold. The smart operator, however, is the one who will take advantage of this tremendous built-up demand to sell himself, his place of business, and his merchandise to old and new customers alike. Many prospective buyers will be shopping around, frequenting automobile sales areas, curious as to the new model cars and their availability. Automobile sales areas will assume more importance than ever before.

The lighting of these sales areas should be carefully considered and improvements planned to create the best possible seeing and selling conditions.

Present lighting equipment in this automobile display room, and method of installation, is of a type that is not conducive to the best selling conditions. A *planned lighting* installation, using modern light sources, modern types of equipment, and functional layout can be used effectively to correct the present conditions. Such an installation will greatly enhance the appearance of the display area, build good will, and make selling an easier job.

The display room is now lighted to an intensity of approximately 14 footcandles. Enclosing glass fixtures, 16 inches in diameter and equipped with 300 watt lamps, are suspended three feet from a twelve foot concrete ceiling. The middle row of fixtures is attached to the bottom of a 24-inch drop I-beam which extends across the entire width of the room. Although this beam is painted a light tan to match the ceiling and side walls, its mass seems to add further to the distracting influence of the suspended bright fixtures. Prospective buyers looking around and examining cars in this area cannot help but be conscious of something taking their attention away from the merchandise. A light colored Terraza floor aids in utilizing the light efficiently and brightening the interior. Displayed cars are highlighted by 100 watt window spots located above the windows in the front of the room only. This lighting fails, however, to create a pleasant, comfortable atmosphere in which the display of automobiles is the main objective.

In the sales office, where sales are closed and clerical work is done, nine footcandles of lighting is obtained from 16 inch enclosing glass globes and 300 watt lamps. This illumination is glaring and spotty, and brightness contrasts are high.

The display parts room is lighted to an intensity of 15

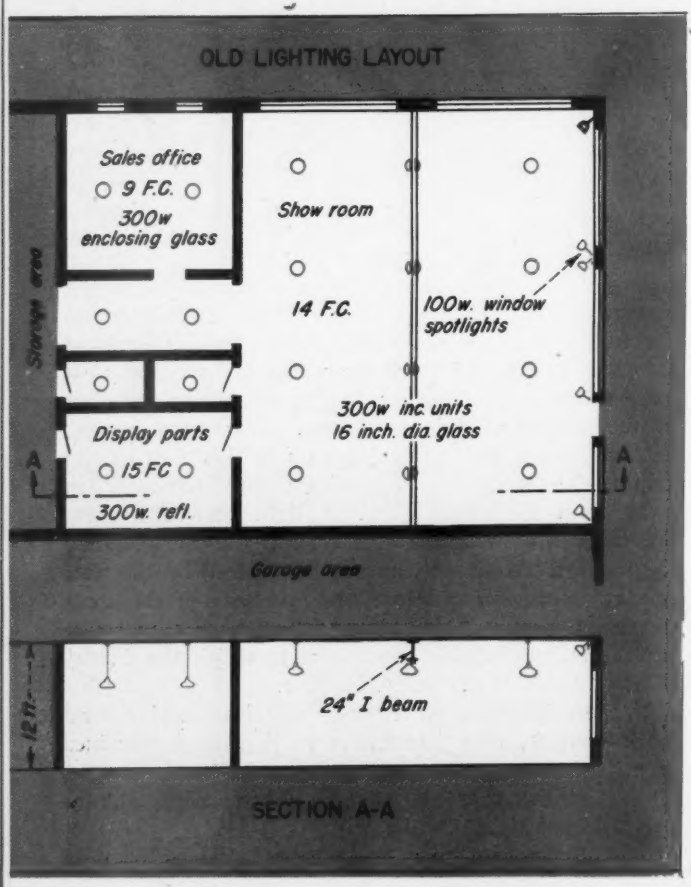
SHOW ROOM LIGHTING *continued*

footcandles with 300 watt lamps in 18 inch diameter standard industrial type reflectors. This illumination lacks the necessary punch for easy seeing of detail, and coverage and distribution is not satisfactory.

The *planned lighting* layout presented here is based on one method which involves only minor changes in these areas. It is an example of one possibility for providing illumination for maximum effectiveness in seeing, selling, and decorative treatment.

Good selling conditions require that the planned changes provide a spacious, attractive appearing interior, in which the sectionalizing effect of the drop beam and the ceiling-lowering effect of suspended luminaires are removed. Adequate general illumination and the proper painting of walls and ceiling is needed to create a pleasant shopping area. Fixture brightness and brightness contrasts in the room must be kept within reasonable limits to avoid confusing highlights which detract from comfortable seeing and cause spotty reflections on the shiny car surfaces. Cars on display must be highlighted to an intensity considerably above general lighting levels, not only for local inspection, but to make them stand out and attract the attention and interest of passers-by.

In order to meet these requirements, general lighting may be provided by a troffer lighting installation recessed in a furred ceiling and supplemented with an indirect cove lighting system along the front and rear walls, together with an indirect trough built around and concealing the obtrusive looking drop beam. Highlighting of the cars can be obtained by incorporating adjustable reflector spots as a part of the recessed lighting system in the ceiling.



In working out the details of this general plan, there is a problem of how far down to fur the ceiling. Since it is desirable to use the I-beam as an element of the indirect trough, sufficient clearance must be allowed from the lamp source in the trough to the ceiling to prevent a hot spot above the trough and to obtain proper distribution of light for coverage of the ceiling. This condition can be met by furring the ceiling down eight inches and recessing shallow type troffers. A quantity of ten troffers, each equipped with six 40 watt lamps are needed. Five rows of three continuous four foot fixtures may be located on eight foot centers in each half of the ceiling separated by the indirect trough. By equipping the troffers with diffusing glass panels, adequate distribution of general lighting throughout the sales area will be obtained.

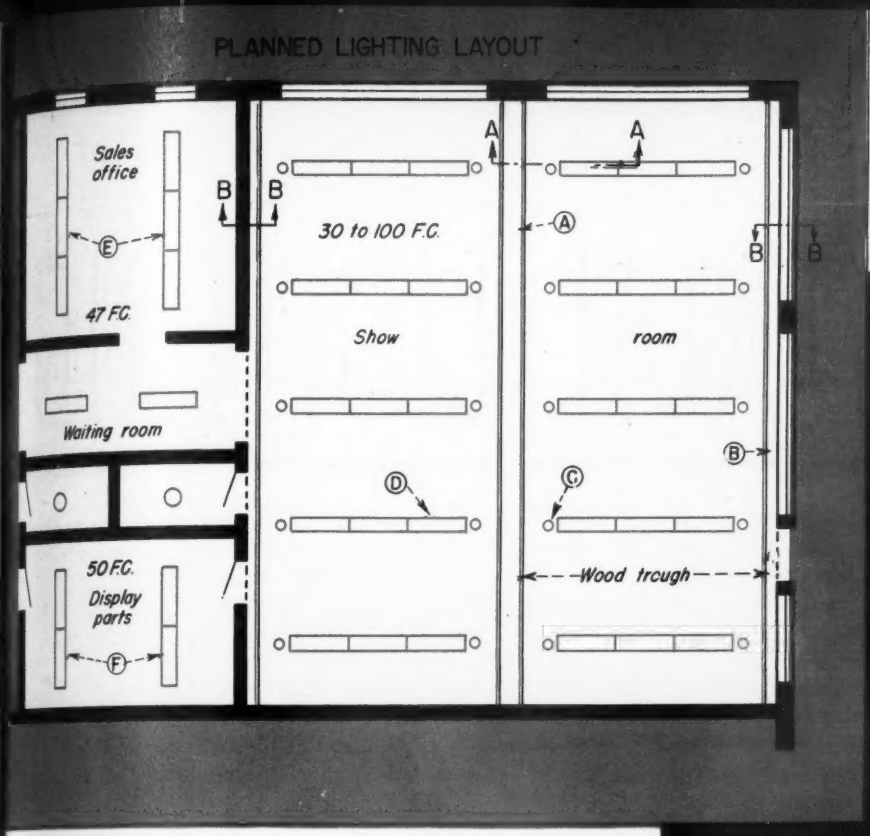
In-service illumination level from this system alone will provide 23 footcandles. Brightness contrast between the glass in the fixture and the ceiling will be fairly satisfactory because of the light reflected from the light-colored Terraza floor to the ceiling. To reduce this brightness ratio further and thus eliminate any confusing highlights in the field of vision, and also to add to the general illumination in this area, indirect lighting from the trough and two coves should supplement the troffer lighting. The coves should extend along the entire length of the front and rear walls.

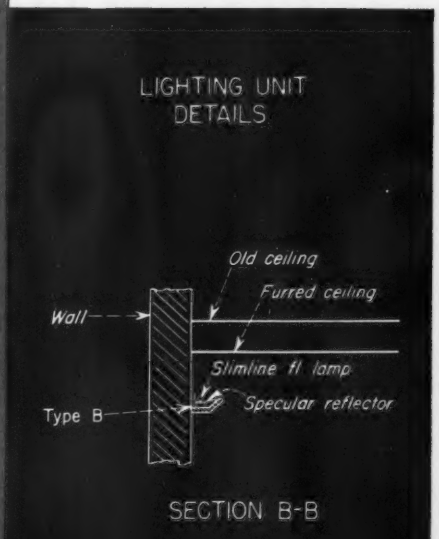
Section A-A shows details for conversion of the drop beam to an indirect trough, while Section B-B shows details of the indirect cove applied to the walls. These must be carefully designed to shield the light sources and to keep down the overall size, so they will not be too noticeable.

The new slimline lamps which are eight feet long, may be installed on standard wiring trough. The ballasts may be mounted in an accessible part of the ceiling. Troughs should be equipped with polished reflectors designed to give an even distribution of light on the ceiling.

Well-distributed light from this system brings the general lighting level up to 30 footcandles of in-service illumination. Each length of wall cove will accommodate five slimline lamps, and the indirect trough in the center of the room will take two rows of five slimline lamps each. The indirect light source for this area will thereby use 20-8 foot slimline lamps. The suspended trough should be painted white, the same as the ceiling. This will minimize this structure, causing it to appear as part of the ceiling construction. The coves located on the wall should be painted the same color as the walls, a light, neutral color, to harmonize with the various colored cars. The color should be sufficiently light to provide a high reflection factor.

Spotlight equipment for highlighting the automobiles should also be installed in the ceiling. Each spotlight should consist of a 150 watt, R-40 reflector lamp located at each end of the recessed troffers. A total of 20 of these adjustable spots, similar to the illustration shown, will provide flexibility and the necessary controlled highlighting. Selected spots can be used to highlight the entire car and at any location at which the cars are placed. Intensities well over 100 footcandles on the cars can be built up with the added advantage of providing lighting in car interiors. With this flexibility also, any





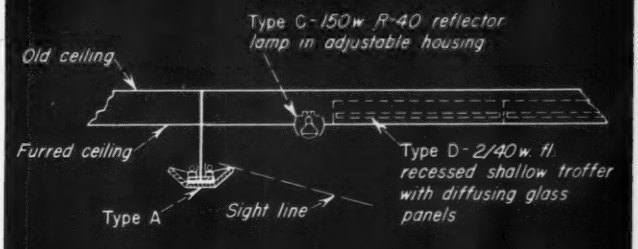
other displays, such as advertising placards, can be made to stand out by spotlighting.

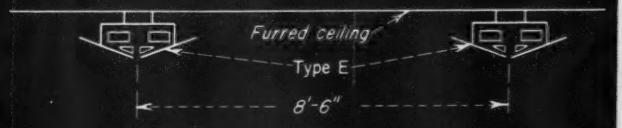
This *planned lighting* will fulfill the requirements of automobile show room lighting. The area will be attractive, comfortable, and accentuate the items on display in a pleasant atmosphere. The overall effect of this installation will also be good from the outside of the building. The entire interior will appear to be a well designed show window. Suspended light sources will no longer mar vision as it did before, the general lighting will be sufficient to make the display area stand out attractively at night, and the spotlighting will flood the cars with a high intensity of light, effectively attracting the attention of the passer-by.

For the sales office, a pleasant, comfortable atmosphere is desirable, and high general lighting levels are required for critical clerical work. An improvement in the appearance of the room may be effected by installing a new ceiling furred down to a height of 10 feet. Four lamp, 40 watt diffusing type fixtures, ceiling-mounted in two continuous rows of three fixtures each, provide satisfactory brightness ratios in the field of vision and produce a maintained lighting intensity of 47 footcandles.

In the display parts area, lighting levels should be increased as better distribution of light throughout the display area is required. In order to get these results, 100 watt fluorescent lamps in standard industrial type reflectors, with two 100 watt lamps each, should be mounted on the ceiling. These units will provide approximately 50 footcandles of well diffused illumination.

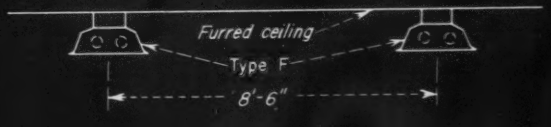
The specific lighting requirements of the automobile sales and service dealer have been made paramount in the design of this *planned lighting* layout. Increased sales and greater profits from all sales areas are sure to accrue from any such modernization. All lighting units and equipment used in this layout are standard production line units or components. Yet it adequately meets the trend of planned functional lighting layout for better seeing, light for selling, and light for decoration.


Type C - 150w. R-40 reflector lamp in adjustable housing
Old ceiling
Furred ceiling
Type D - 2/40w. fl. recessed shallow troffer with diffusing glass panels
Type A
Sight line
SECTION A-A



Sales office

Two 4/40w. fl. continuous row diffusing glass bottom units each twelve feet long



Display parts

Two 2/100w. fl. continuous row refl. units each eleven feet long

Planned INDUSTRIAL LIGHTING

RECENT surveys indicate that approximately 40,000 small industrial plants, employing 250 workers or less, are today inadequately lighted. About 45 percent of the nation's total production comes from these plants. It is reasonable to assume that larger plants, some of which were modernized and relighted for producing war materials, have additional lighting requirements equalling those of the small plants. The potential relighting market for industrial lighting thus takes on substantial proportions. To this must be added lighting for new plant construction, which is expected to equal, or exceed, the relighting market.

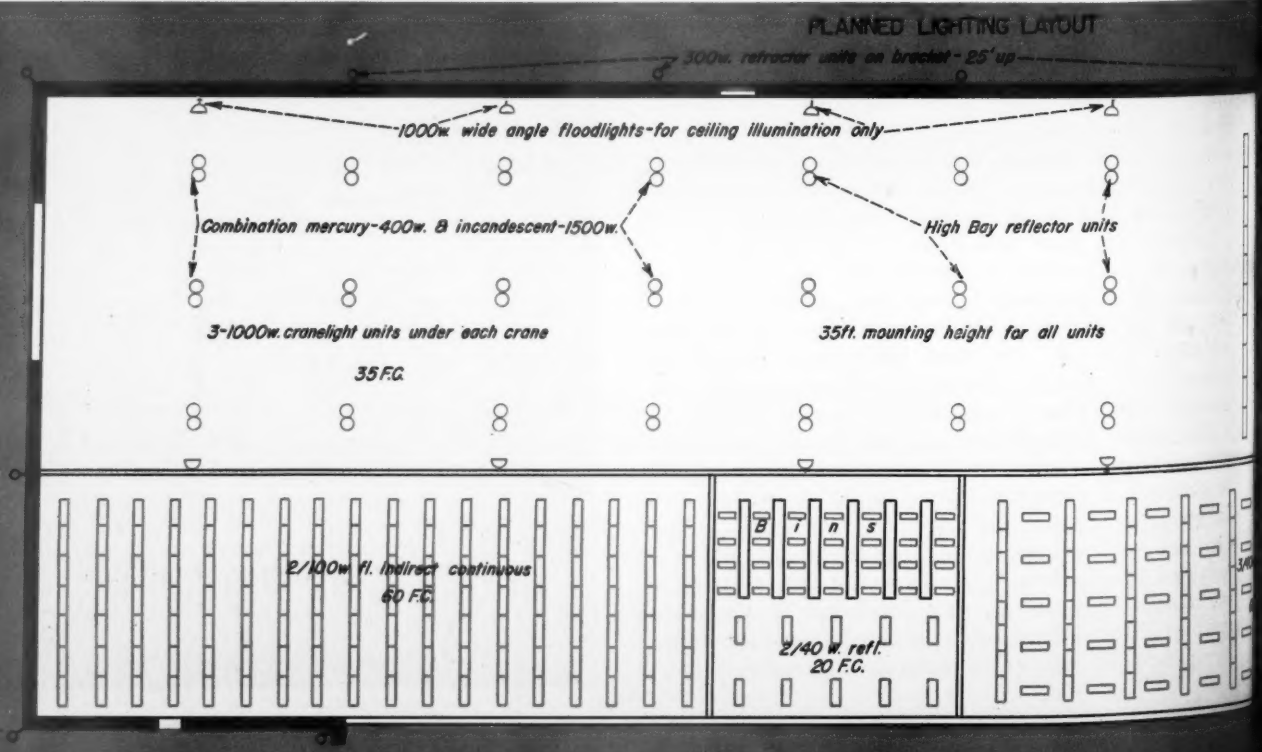
In the peace economy, competition in industry is again a major factor. Factory managers find it essential to check their lighting to insure working conditions which place them in a favorable competitive position. Workers, who have returned, or are now returning, to civilian production have experienced the benefits of good illumination in modern war plants. They have a better appreciation of its comfort and health value, and will now demand proper "seeing" conditions. Alert production managers today realize that good lighting is a working tool. In order to obtain maximum output with minimum labor, they will insist that production areas are adequately lighted in order to cut down manufacturing costs.

The factory shown here is a hypothetical plant. It has been selected to demonstrate lighting requirements for diversified operations and various building conditions. One seldom finds a sewing room in juxtaposition to a welding department. But the problems presented, and the remedies suggested are typical of the industrial field. With slight modifications, all have been taken from the records of actual experiences during recent months.

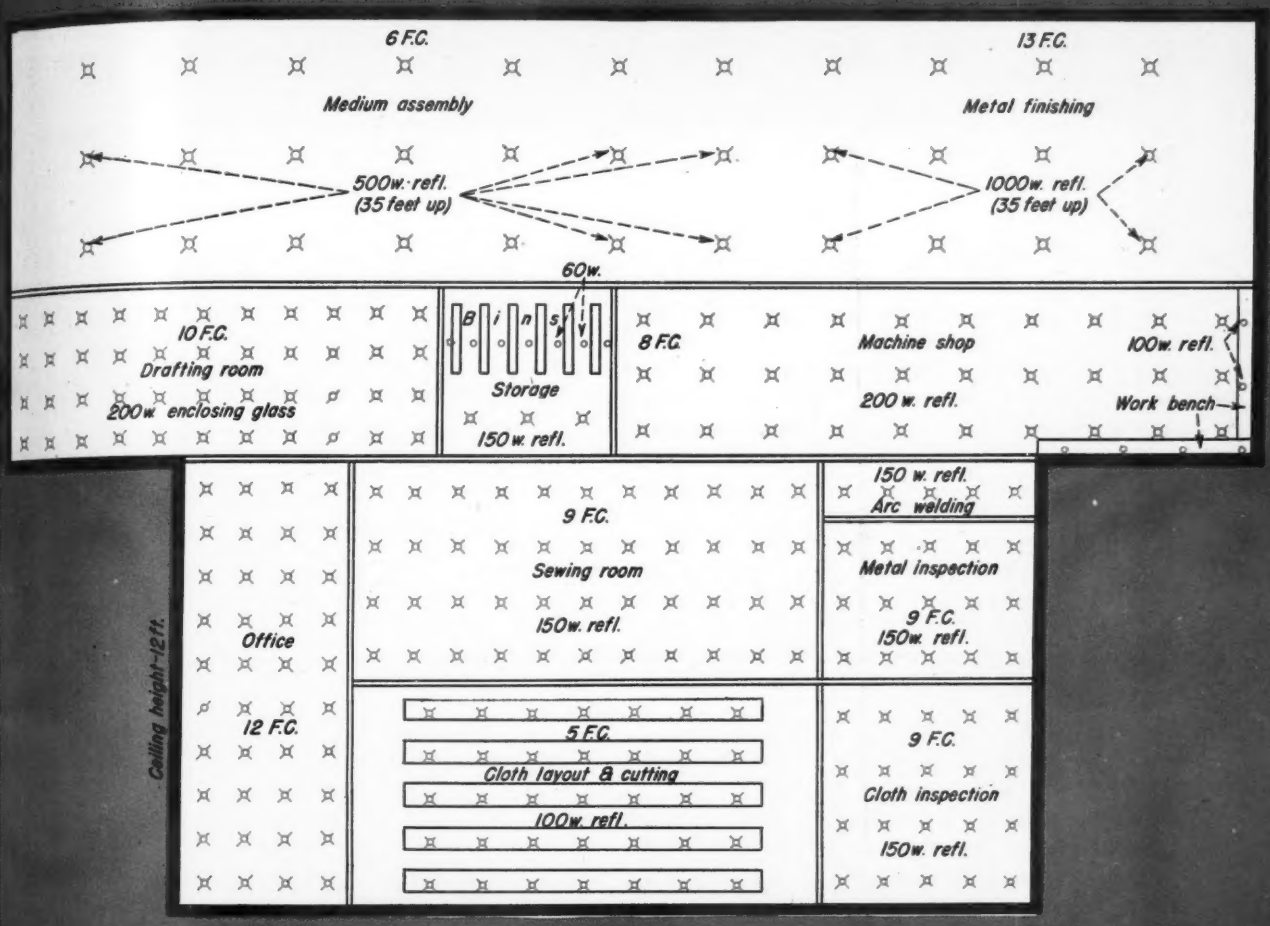
The building selected is a one-story structure. It has a high bay section at the rear, 60 feet wide, with a 48 foot high ceiling. A crane operates through the entire section. The ceiling height throughout the remainder of the plant is 12 feet.

Upon superficial inspection, it might be considered that this plant is adequately lighted. The old lighting layout shows the lighting outlets to be well arranged and properly spaced. There also appear to be an adequate number of fixtures. It is typical of lighting in thousands of America's industrial plants today. A careful analysis of each area, however, such as has been made in the *planned lighting* study, points out many faults and costly weaknesses in the old lighting layout. Improved lighting will represent a profitable investment, brought about through employee contentment and better production.

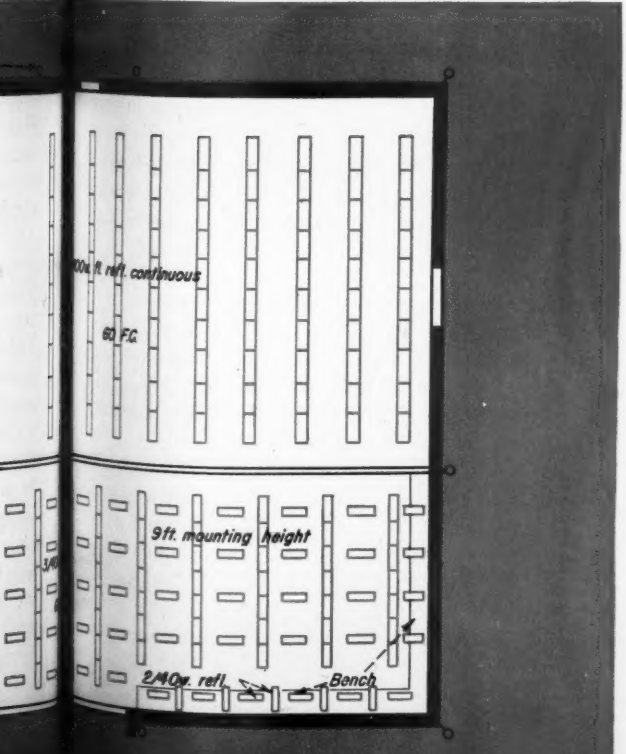
Medium Assembly—Assembly operations, handling, and trucking are done in the medium assembly section of the high bay area. The old equipment provides six footcandles of illumination, wholly inadequate for fast, efficient work, and the prevention of accidents.


PLANNED LIGHTING LAYOUT
300w. refractor units on bracket - 25' up
1000w. wide angle floodlights - for ceiling illumination only
Combination mercury - 400w. & incandescent - 1500w.
High Bay reflector units
3-1000w. cranelight units under each crane
35 ft. mounting height for all units
35 F.C.
2/100w. fl. indirect continuous
60 F.C.
B i n s
2/40 w. refl.
20 F.C.

OLD LIGHTING LAYOUT



Higher lighting intensities, and less contrast between lighting units and a dark ceiling, which will minimize glare, will measurably increase worker comfort. The use of combination mercury-incandescent two-reflector units installed 35 feet from the floor, each equipped with one 400 watt mercury lamp and one 1500 watt incandescent lamp, will provide 35 footcandles of illumination. Better color quality will result, and vision will be speeded up and made easier. The high contrast between lighted reflectors and the dark ceiling can be relieved by the installation of eight 1000 watt angle floodlights directing their light to the ceiling. Supplementary lighting, consisting of three 1000 watt cranelights, will provide additional light where most needed by the crane operators.

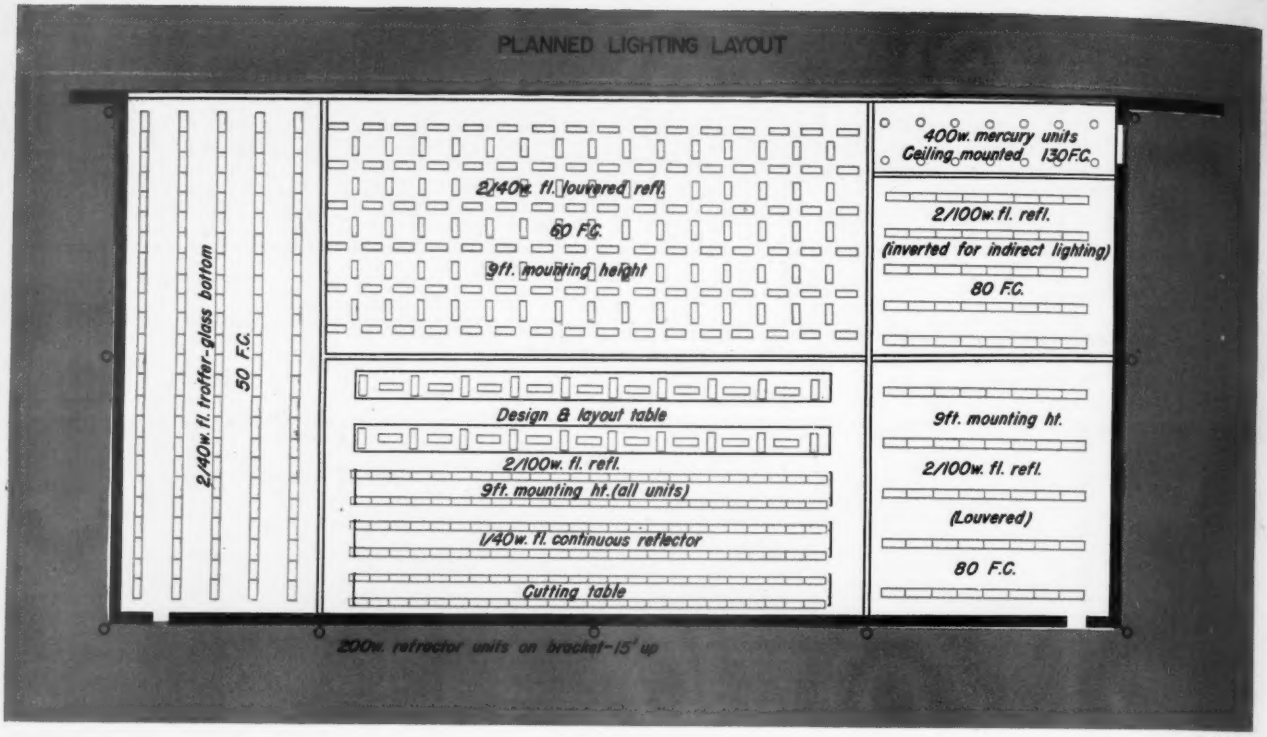


Metal Finishing—Metal sheets, many of which are highly polished, are inspected in the metal finishing section. The 1000 watt incandescent lamps and reflector units of the old installation show up on the bright surfaces as reflected glare.

Satisfactory lighting, free from objectionable glare on the metal sheets, can be obtained with continuous row fluorescent reflectors. These must be installed 35 feet high to clear the cranes. Reflectors using two 100 watt lamps each, and spaced as shown on the *planned lighting* layout, will provide 60 footcandles of diffused, comfortable illumination.

Drafting room—Ten footcandles of direct lighting from 200 watt enclosing glass units in the old installation is unsatisfactory for drafting room lighting. The intensity is too low, and shadows are annoying to the draftsmen, slowing up their work.

Improved seeing, and better working conditions can be obtained with high intensity indirect lighting. A flat white ceiling, and two rows of 100 watt fluorescent lamps in each continuous indirect lighting trough, located as shown, will provide 60 footcandles of shadowless illumination in this area.



Storage—Loss of time in locating stocks, mix-ups of parts, and general accumulation of miscellaneous odds and ends, can be prevented in the storage and stock bin areas by the use of correct types of lighting equipment, properly located and installed. Two-lamp 40 watt fluorescent reflector units, installed at right angles to the bins, will allow light to be projected into the shelving, and will produce a shielding effect as one approaches the bin aisles.

Machine Shop—General illumination under the old lighting layout averages eight footcandles. Limited work areas under the 200 watt industrial reflectors on drop cords are lighted to as high as 200 footcandles in some cases. This produces annoying glare spots. The contrast between the work and general surrounding area breaks one of the most important rules of good lighting practice.

Several factors determine the *planned lighting* for this area. One is the reduction in brightness contrast ratio between the work and surroundings. With the old ratio being about 25-to-one, a reduction to three-to-one would be a genuine improvement. This is accomplished by changing to three-lamp 40 watt fluorescent reflector units installed nine feet from the floor, and spaced as shown in the new layout.

Another important factor is that reading of dials and verniers on the various machines be made easy. A grid arrangement of the fixtures will effect this advantageous result. A similar installation of two-lamp 40 watt reflectors over the work bench will eliminate shadows that confuse and tire out bench mechanics.

Office—Twelve footcandles results from 200 watt 14 inch enclosing glass units in the office. This is entirely inadequate for comfortable office lighting. Reflection of the direct lighting type units in polished surfaces, such as typewriter keyboards, and paper with a sheen surface, causes headaches and eye fatigue.

Two-lamp 40 watt continuous troffers, with diffusing glass bottom, recessed flush in the ceiling and spaced as shown, will result in 50 footcandles. This is ideal for efficient desk work. The troffers should be arranged to run lengthwise, to prevent the units appearing to blend into one large light source and causing some glare, when viewed from either end of the room.

Sewing room—General illumination is nine footcandles, with localized lighting on each machine. Work areas are lighted to 60 footcandles. The machines are portable, to permit efficient grouping to handle special production.

Planned lighting based on a general intensity equivalent to present work area lighting is considered practicable. Louvered fluorescent two-lamp 40 watt reflector units, arranged in grid pattern, produces 60 footcandles of uniform and efficient lighting, practically shadow free for operators, regardless of floor position of the machines.

Cloth inspection—Ideal illumination for general cloth inspection, totalling 80 footcandles, is obtained with egg-crate louver-shielded two-lamp 100 watt reflector units installed in continuous rows. This layout should replace the nine footcandles of general lighting obtained from 150 reflectors in the old system.

Metal inspection—General illumination of nine footcandles from 150 watt reflectors is not conducive to proper inspection of small finished metal products in this section. This type of inspection requires a different quality of lighting from that used for inspecting polished metal sheets. A high intensity of 80 footcandles of indirect lighting meets the requirements of this exacting operation. It is obtainable with two-lamp 100 watt reflector units suspended upside down two feet from a flat white ceiling.

Arc welding—One of the primary objects in lighting a welding area is to counteract eye shock which ordinarily occurs when a worker lifts his helmet after making a weld. Lighting from 150 watt reflectors in the old layout is practically useless for this purpose.

Unusually high intensity lighting of 135 footcandles will result from 400 watt mercury vapor units installed on seven foot centers. This type lighting will permit welders to work faster, with less lost motion. No time-lag is necessary to permit eyesight adjustment between welding work and work resetting. Welders will find it possible to move about, shift parts, change jigs and positioners without raising their goggles.

Planned OFFICE LIGHTING

IN THE office modernization program now getting under way, lighting tops the list of proposed improvements. With most offices poorly lighted at the beginning of the war, and unable to obtain lighting equipment during the last four years, the demand for better lighting is now unprecedented.

Office managers recognize that efficiency in the office is as important as on the factory production line. If high intensities of comfortable illumination contribute to increased production in the plant, they recognize that it will also speed up office work, decrease errors, prevent eye strain and resulting headaches, and create better employee morale.

Office employees are now educated to the advantages of good lighting. No longer will they be content with low intensity lighting in dismal surroundings. No longer will they be satisfied with lighting which results in eye strain and fatigue, due to unshielded light sources, and direct or reflected glare. Neither will the progressive business firm want its employees working under conditions conducive to absenteeism and possible costly mistakes.

Shown here is a suite of offices in a large office building. Included are general and private offices, a drafting room, and a reception room. These are typical of office areas located in every contractor's community throughout the country.

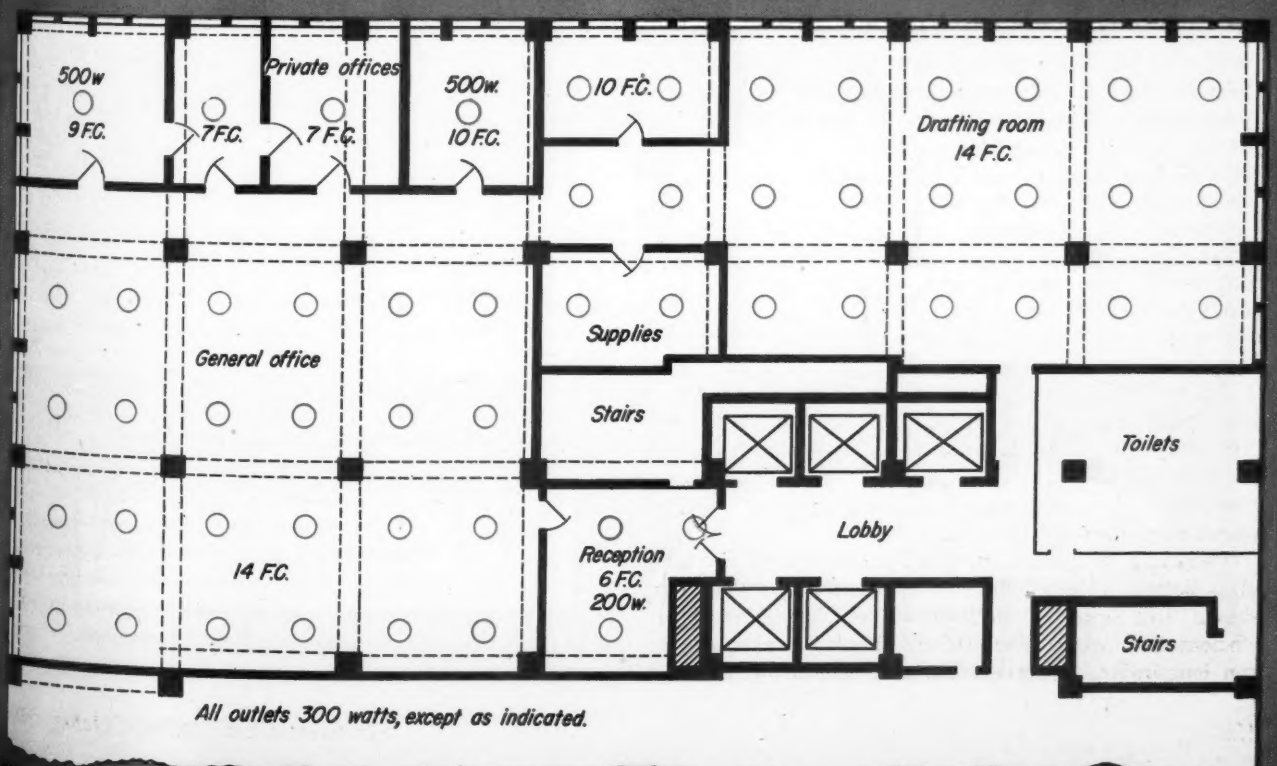
Present lighting in these offices, shown in the old lighting layout, is generally representative of office lighting today. The lighting fixtures in use are enclosing glass globes suspended two feet from the ceiling, equipped with 300 watt lamps. Two of the private offices are lighted with 500 watt semi-indirect bowl units. Footcandle intensities range from seven to 14 footcandles. It is entirely inadequate for today's efficient operation of the modern office, where critical seeing tasks must be performed constantly and at high speed.

Modern office lighting requirements are threefold. There must be a sufficient quantity of light. The quality of lighting must be appropriate for the type of work done. The lighting system must be efficient. The measure of efficiency, however, is not limited to the production of raw footcandles with a minimum of wattage. Efficiency must be measured in terms of producing adequate light of proper color quality for seeing comfortably and easily. Direct and reflected glare must be eliminated. General appearance of the lighted room must be good. In other words, the efficiency of a modern lighting system must be measured in terms of how well it produces a satisfactory *lighting result* which will aid in the efficient handling of the various office tasks.

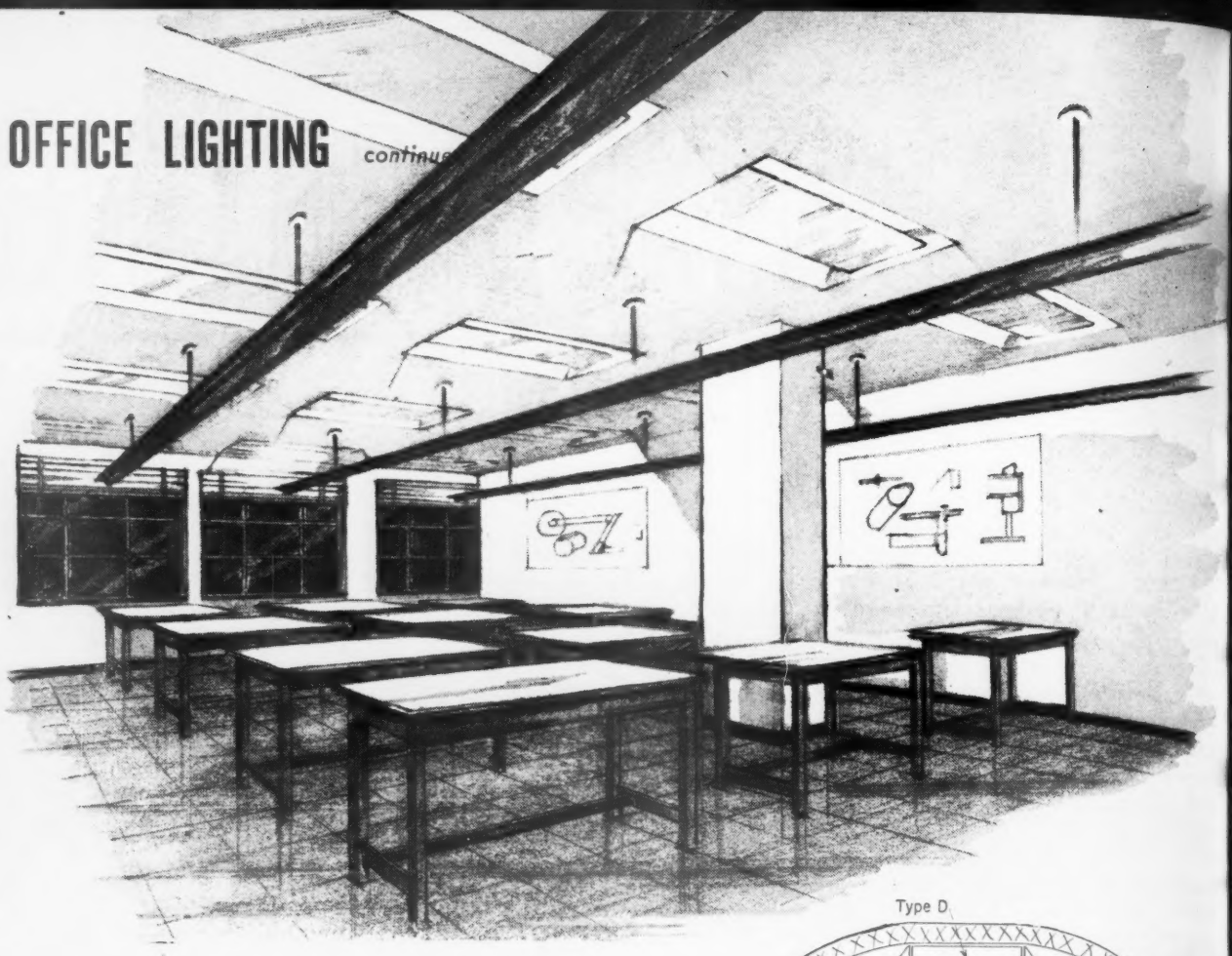
Planned lighting offers an ideal solution to the lighting problem involved in the modernization of these offices.

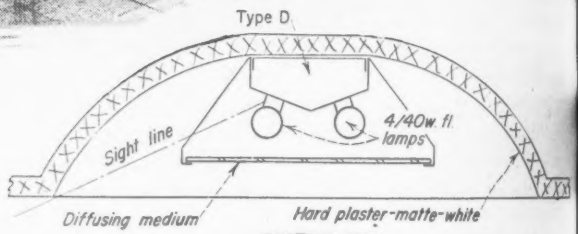
The reception room should present a quiet, dignified approach to the offices. A comfortable intensity of indirect lighting creates the proper atmosphere for this room. Lighting is made functional by use of a ceiling coffer leading from the lobby entrance to the office entrance. A similar coffer branches off over the recep-

OLD LIGHTING LAYOUT



OFFICE LIGHTING continue





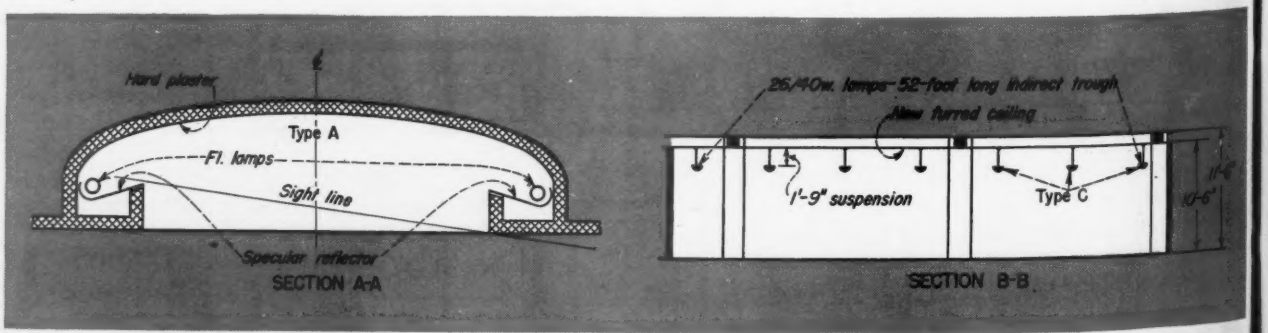
SECTION E-E

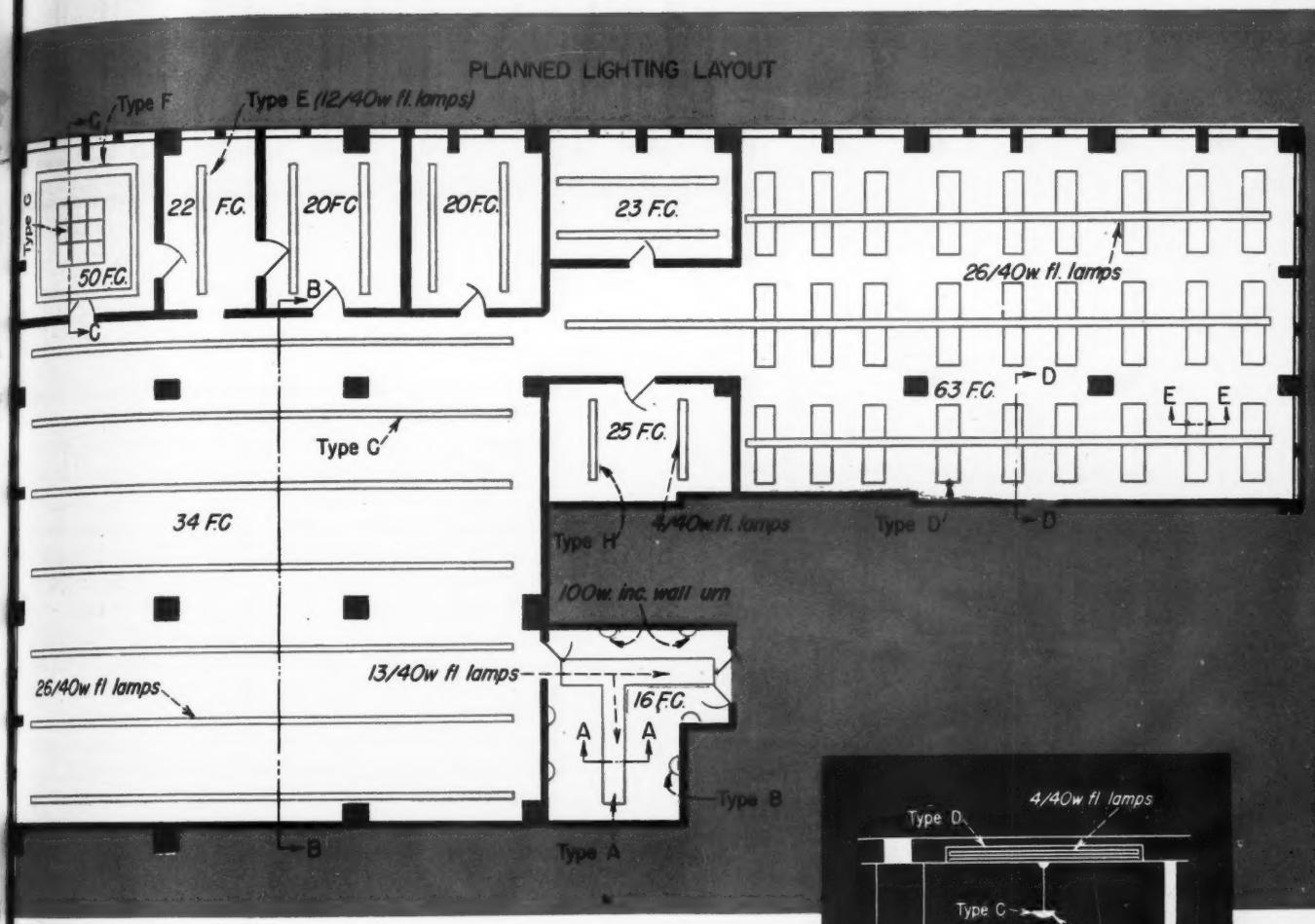
tionist's desk. These coffers (Type A) are equipped with fluorescent lamps in specular reflectors, as shown in Section A-A. Six 100 watt ornamental wall urns are spaced about the perimeter of the room to light the ceiling evenly and to supplement the coffer lighting.

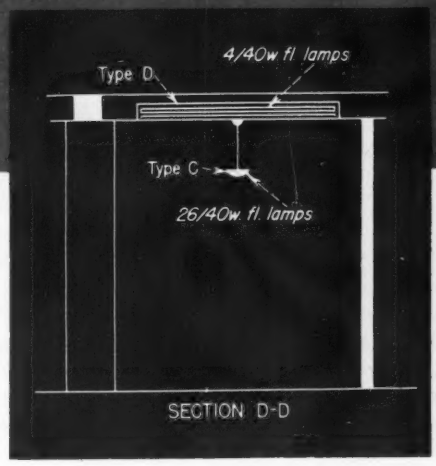
The general office area has exposed beams between columns throughout and a plaster-on-concrete ceiling. The first change made here is to install a furred acoustical ceiling, which will eliminate the exposed beams. Seven continuous row indirect troughs (Type C), each 52 feet long, are then suspended 21 inches from the furred ceiling. Each indirect trough contains two continuous rows of 40 watt fluorescent lamps. These indirect troughs will provide over 30 footcandles of glare free illumination, free from excessively bright surfaces, and will completely shield all lamps.

The four small private offices used by executives and secretaries are provided with the same type of comfortable indirect lighting. Footcandle intensities are slightly less, for the same watts per square foot, than in the general office, due to the lower utilization factor of a smaller area. Two continuous rows of 40 watt fluorescent lamps are used in each trough (Type C), except for the office of the president's secretary. Here, because of the size of the room, only one trough is desirable. Since eight 40 watt lamps would not provide adequate light, the indirect trough (Type E) is modified to use three continuous rows of 40 watt lamps.

An unusual flexible lighting arrangement is made in the president's large corner office. With large window areas forming two walls, utilization of light is low. A combination of indirect and direct lighting is therefore provided, affording three separate lighting results. An indirect lighting trough (Type F), rectangular in plan, conceals 16 - 100 watt fluorescent lamps for high intensity indirect lighting. Lamps adjoining the two inside walls

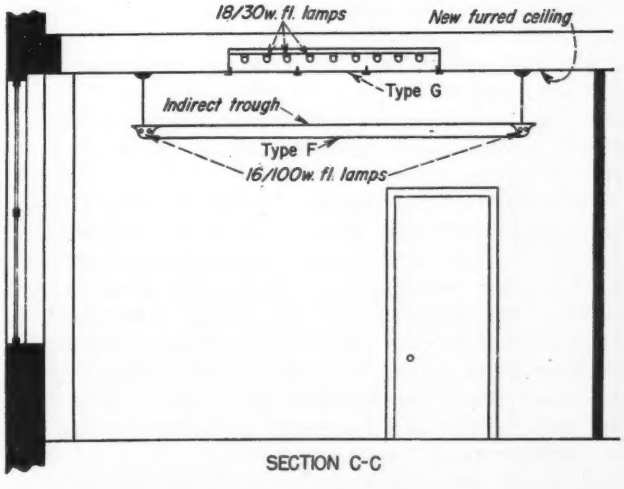




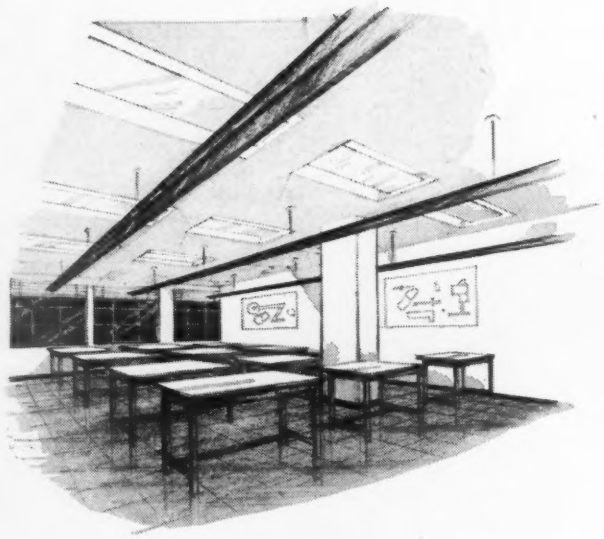


are controlled by a separate switch for daytime use. Direct lighting is provided by a large surface, low brightness ceiling panel (Type G). It consists of flashed opal diffusing glass set flush in the ceiling in a six foot square panel, and illuminated with 18 - 30 watt fluorescent lamps mounted in a metal housing, finished flat white inside. The lower surface of the glass panels is roughed to prevent reflection of lamps from the indirect trough.

A direct approach to the problem of drafting room lighting has been made. Shadows from T-squares and triangles must be practically eliminated. A high intensity of light must be provided to speed work and prevent undue eyestrain for this critical seeing task. Slight specular reflection, adequate to enable quick seeing of fine detail, is desirable. The basic solution to this problem is achieved through the use of a shielded direct lighting type eight foot long fluorescent unit (Type D). Each unit uses four 40 watt 4500° white lamps. The diffusing medium is carefully selected to control reflected glare. Each unit is recessed in an arched soffit to prevent direct glare, to provide a large surface of low brightness, and to further soften shadows from this direct lighting type unit. In order to relieve contrast between these lighted soffits and the unlighted ceiling, and to further soften shadows, three continuous row (Type C) indirect troughs are suspended from the ceiling. Over 60 footcandles of uniform diffused white light, glare and brightness controlled, forms a lighting result well suited to the critical seeing problems of the drafting room.



HOW TO SELL



Office

MODERN lighting systems are designed, planned and installed for just one purpose—to produce a desired lighting result. The selection of light sources, fixtures and layout, the choice of proper intensity or cost, are all subordinate factors, "nut and bolt" problems, in relation to the overall task of producing a planned and predicted lighting result. And right here is the key to sales promotion and development for the lighting markets opening up today—*planned lighting* for specific lighting results.

When lighting was a feeble compromise with the surrounding darkness, when an orderly pattern of fixtures of reasonably pleasing appearance constituted the best we knew how to do, planning was comparatively unimportant. Practical lighting results lay within a fairly narrow range. Design and engineering were pretty much a manufacturer's problem. Customers, too, were non-critical. They wanted to be able to see comfortably. They wanted an attractive installation. They wanted reasonably modest light bills.

It is understandable, therefore, in the past era of lighting development that the emphasis in sales promotion was on types of fixtures. The contractors handled lighting fixtures like a thousand other devices and items of apparatus. The lighting result was defined in footcandles which were sometimes varied to meet specific needs by closer or wider spacing of standard units. Lighting systems were "direct" or "indirect", fluorescent or incandescent, and the classifications were in themselves ends to be sought or results to be accomplished.

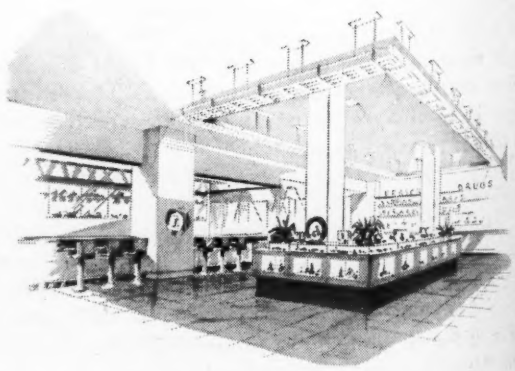
All trends today, however, show a marked emphasis on solving particular lighting problems and producing specific lighting results, by planned, engineered lighting, using a variety of sources, components and fixtures.

Planned functional lighting does not require special fabrication of lighting equipment for every job. In the early stages of most important lighting trends, much of the apparatus must be specially designed and fitted. However, the extraordinarily wide range of light sources, fixtures and components already catalogued or in process of design by leading manufacturers today are adaptable for practically any job that will be encountered. Essentially all of the modern techniques illustrated in these pages, for instance, can be developed with components available from a number of well known and reliable manufacturers.

Since coordination with architectural features, proper installation, effective layout and convenient control play an even more important part in *planned lighting* than the selection of the equipment, the contractor must assume much more responsibility for sales than ever before. While utility lighting sales departments, wholesalers and manufacturers' representatives have done and will continue to do an aggressive sales job, their work must be supplementary to the contractor's sales effort and not a substitute for it.

This responsibility of the contractor for aggressive and self-energized sales effort is of compelling importance today. It is dictated by the trends in lighting techniques. It is required by the very nature of the market.

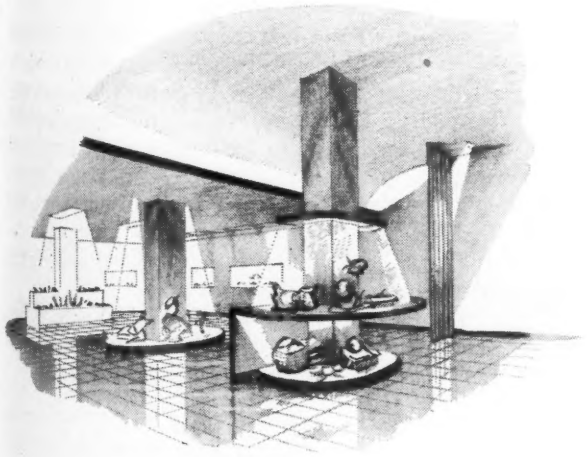
The market in lighting modernization today is the result of rapid progress in lighting techniques at a time when public wants could not be satisfied. The pent up demand can be relieved with almost any moderate improvement



Drug Store

in present lighting installations. On the other hand, it is a natural for creative market development. It can be employed to bring a new era in illumination of tremendous public benefit and new business horizons for the electrical industry.

Both the large market potential and the possibility of creative development provide the basis for soundly profitable business that can well afford to support enterprising sales and engineering activity by the contractor. The aid and cooperation of utility sales departments and manufacturers' representatives should be sought and used to

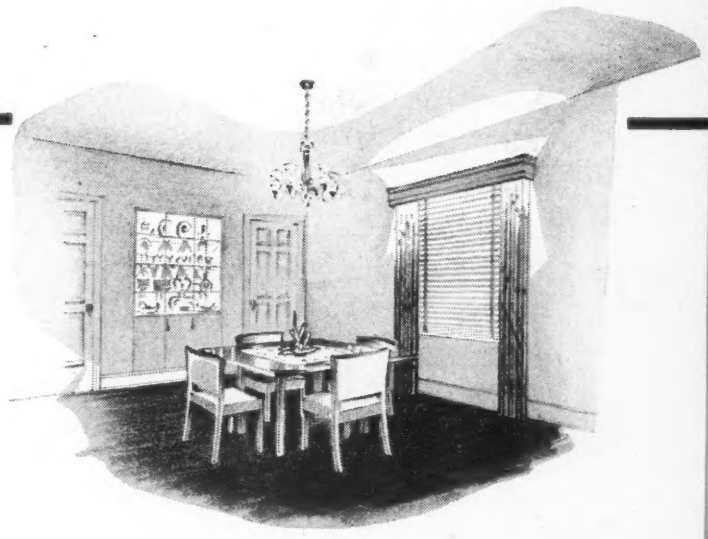


Store

the fullest advantage; however, the contractor's own sales program must be developed to stand squarely on its own feet and be in a position to act independently and competently.

Effective lighting sales depend on sound organization. Lighting sales should be developed as a major specialty. Select one man from your present organization, or bring in a competent lighting engineer, and make him fully responsible for all lighting, engineering and sales. He must be well grounded in illumination methods and techniques. He must be fully up-to-date on new lamps and fixtures. And he should have the imagination and enterprise to fully appreciate the market and its opportunities for development.

The organization should be set up to (1) seek out prospects for lighting modernization, (2) appraise local industries and commercial establishments in terms of po-



Residential

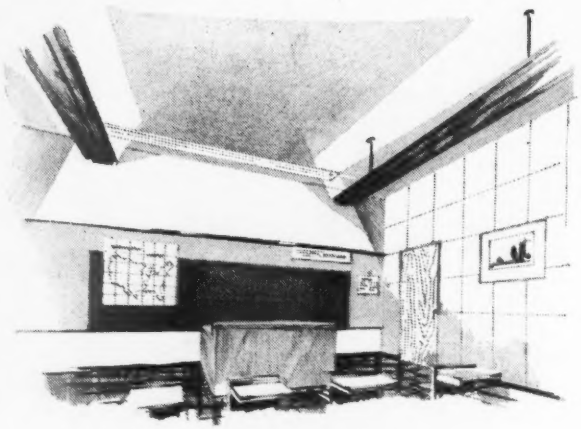
tential opportunities for lighting modernization, (3) contact architects and builders at the planning stage of new construction to initiate modern illumination design practices, (4) approach school boards and other civic bodies to influence institutional building and modernization, (5) follow up prospects with sound selling methods, (6) survey and plan lighting jobs, (7) prepare effective sales presentations, (8) supervise installations of *planned lighting* systems, (9) coordinate the associated wiring, painting and other work necessary to the lighting installation, and (10) sell and carry out *planned lighting* maintenance contracts.

Whether the organization is small or large, it must be prepared to do all of these efficiently, effectively and profitably. If prospects are approached on the basis of prewar illumination practices, against straight price competition and at competitive bidding margins, the market will support neither individual sales efforts nor creative market development. On the other hand, an organization geared to sound sales methods, up-to-date engineering and a realistic and courageous price policy, can write its own ticket.

The lighting sales engineer will need the full support of your wiring department, estimators and salesmen. All lighting prospects and tips should be developed under his direct supervision.

In this particular period of economic reorganization, it is especially important to analyze critically all plans and specifications that come into the shop for obsolete lighting designs and layouts. Many plans that were shelved during the early war months will be coming out pretty much intact in an effort to speed construction. And many of these plans require modernization of lighting layouts to bring them in line with present day thinking and techniques. Much of the development of fluorescent lighting, for instance, has occurred *since* the beginning of the war. The chances are that plans drawn prior to that time are comparatively obsolete today as a result of recent technical progress.

The sales approach on modern lighting must also be



School

coordinated with a thorough survey of wiring, feeders and service equipment. Few *planned lighting* jobs can be developed without considerable addition and alteration to the existing wiring system. And because the wiring and lighting job must be considered together, the contractor has a larger responsibility for the effective operation of the system than ever before.

Advertising is essential. While potential customers are anxious to buy modern lighting, most of them do not know where to buy what they want. Modern functional lighting is new. The contractor must tell his potential customers that he is in that particular business and is ready to design and install the kind of lighting they have been hearing about.

What kind of advertising and publicity will work best for the individual organization depends on local conditions and local market. Newspapers, local magazines, Chamber of Commerce organs, direct mail, telephone book space, etc., all have advantages. The important point is to get the word out to the kind of customers you want to get and make them realize that you are organized to give them a modern lighting service.

A showroom is highly desirable though not absolutely essential. It should avoid the familiar inverted forest of fixtures. It should consist of plenty of movable partitions and a hung ceiling for developing lighting effects with built-in equipment. It should have more of the aspect of the laboratory than the display room and should provide a place for setting up combinations of equipment to demonstrate particular lighting plans.

On every job, no matter how small, make a thorough analysis of the lighting problem and the desired lighting results. Then, if it is necessary to trim the job because of a limited budget, the compromise can be made within the planned layout and in such a way that the complete lighting plan can be developed from time to time as circumstances permit. Such lighting plans should be held in an active file and checked regularly through a methodical follow-up system.

Proposals should be developed as skillful sales presentations. The lighting plan should be well executed with plenty of detailed sketches to show how the installation will appear when it is completed. A few dollars worth of skillful art work on the presentation will pay off many fold in quick and profitable sales. Further, a professional and well prepared presentation effectively brushes off competition.

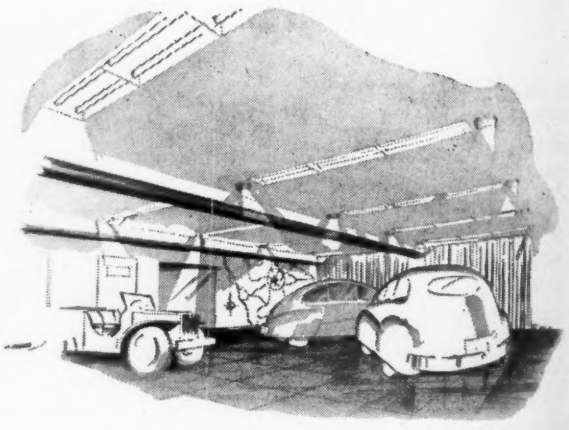
Use current jobs as sales tools. Photos taken during an installation can be used to show the how and why of necessary rewiring or methods employed to minimize interference with store operation. Examples of what others have done can also be employed effectively in the sales presentation when similar lighting methods are being prepared. Good lighting jobs quickly become local landmarks. Identify your organization with them.

Cooperate with the local or regional chapter of the Illuminating Engineering Society and play an active role in cooperative industry lighting promotion plans. By fostering better engineering, stimulating public understanding of the importance of good illumination and industry education such organization and industry activities can help you get more business and better business.

How well the electrical industry serves the public, how quickly and effectively new products and methods are put to effective use and how efficiently we develop the tremendous market potential in lighting, rests squarely on the men who plan and install lighting systems.

The sales effort we put into the job will determine the size of the market and its profit potential to every branch of the industry. It will take close liaison between the contractors and the manufacturers of lighting equipment. It will take constant study to seek out new products and new practical lighting techniques. It will take a broad understanding of wiring, paint, color, and similar related problems. It will take, too, a keen study of lighting problems in individual establishments and a broad knowledge of industrial and commercial practices.

The sales methods and techniques employed will be important, but no less important will be the energy, enthusiasm, skill and courage of the men behind them.



Show Room

ADVERTISEMENT

SYLVANIA NEWS

CONTRACTOR EDITION

OCTOBER *Published by* SYLVANIA ELECTRIC PRODUCTS INC., Salem, Mass. 1945

LIST OF SYLVANIA ELECTRIC LAMPS EXCEEDS 2,000 TYPES

Sylvania Electric has developed and produces a line of over 2,000 types of lamps – fluorescent and incandescent – to fill almost any lighting requirement.

Many of these lamps are designed for use in various types of equipment where special lighting jobs are needed or where unusual performance characteristics are necessary. The scope of wattages, voltages, bases, bulb shapes, filament types and light outputs available is so wide that practically every requirement for equipment lamps can be met from the standard list.

Lamps designed for use in ordinary capacities have been built to take various kinds of punishment. Of these there are lamps with vibration-resistant filaments for use near heavy, pounding machinery or wherever vibration may harm an ordinary lamp. Rough service lamps have also been developed to take hard knocks and still give long, useful service.

For lighting the interiors of bake ovens, there are Sylvania bulbs that will operate efficiently in temperatures of 550°; and for operation in refrigerators, there are Sylvania vacuum lamps that give good light with a minimum of heat.

SYLVANIA KNOW-HOW

The research that went into the development of many of these special lamps has helped all along the line in making Sylvania lamps tops for lighting quality. The know-how learned in developing a lamp that few people might use has, in many cases, made it possible to improve further a more commonly used lamp. That is why Sylvania has put so much effort into solving these tough "little" problems in lighting.

SYLVANIA DEVELOPS NEW WHITE FLUORESCENT LAMP

Fills Need for Color Between Standard Daylight and White Lamps

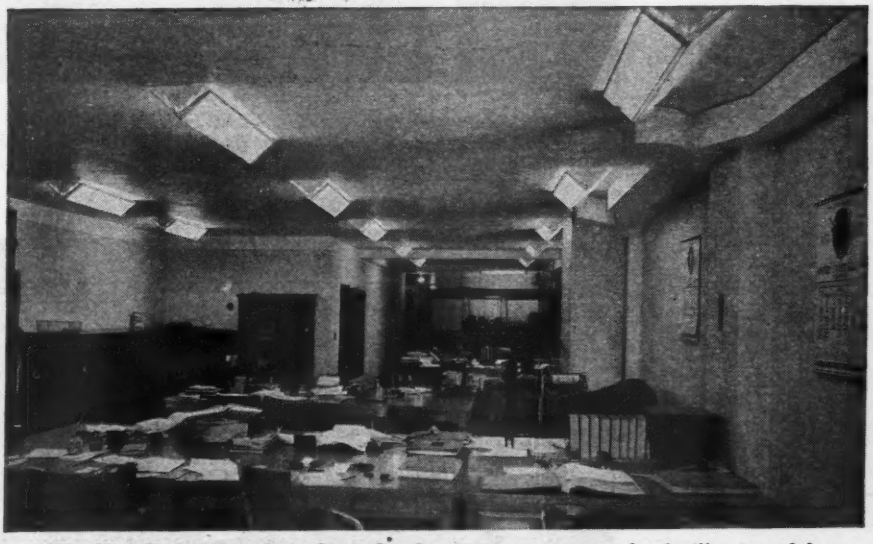
A new white fluorescent lamp recently developed by Sylvania Electric has a color near daylight and yet delivers over 10% more light than the usual Daylight fluorescent lamps.

This lamp has been produced after several years of development work, to satisfy a consistent demand for a lamp having a color between the Daylight and White lamps. The new lamp will be designated as 4500° White (the standard Daylight lamp is 6500° and the regular White lamp is 3500°). This 4500° color gives a light which is "whiter" than the White and not as "blue" as the Daylight.

Since the 4500° White lamp gives nearly the same amount of light as regular white lamps, it will find wide use wherever a very white, near-daylight illumination is preferred. It will be available in the 40 Watt T-12 and 100 Watt T-17 sizes and will have the same lumen maintenance ratings as other 40 and 100 Watt fluorescent lamps.

The 4500° White lamps are an addition to the line of new Sylvania developments – which include the Long-Slim fluorescent lamps. These new lamps are of the instant-start type and require no starters – simplifying the installation of systems using them. They will find wide use in continuous row lighting because of lengths up to 96" and also will be ideal for showcase and display lighting.

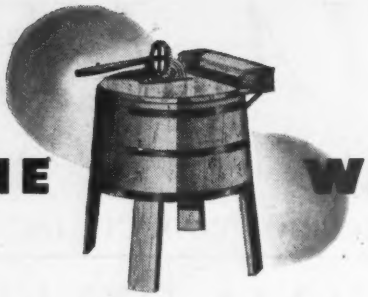
U. S. LEATHER CO. OFFICE SYLVANIA LIGHTED



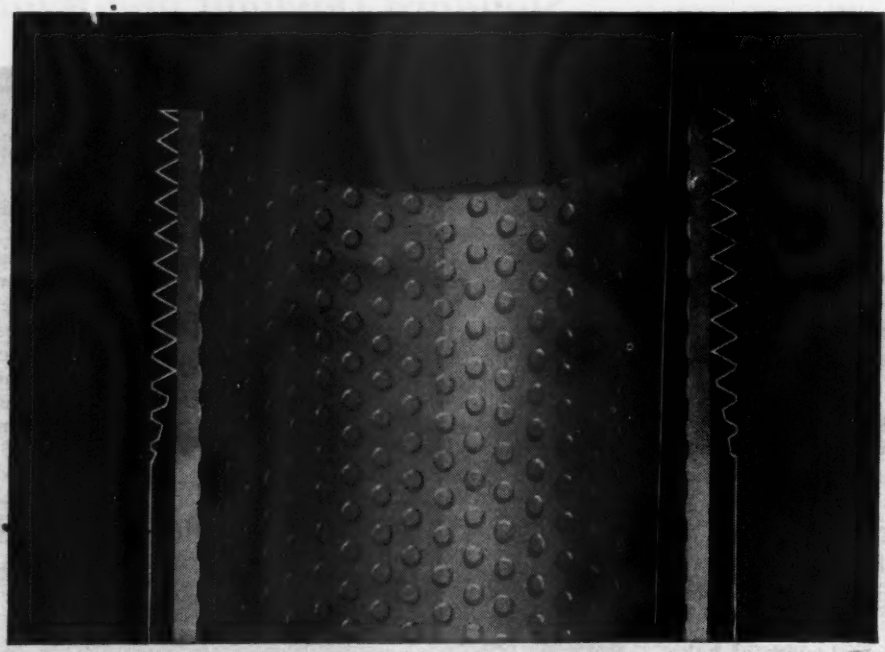
The New York office of the U. S. Leather Company is now clearly illuminated by Sylvania Electric commercial fluorescent fixtures. This view is of the accounting department, where surface-shielded fixtures are mounted flush against the ceiling to provide a high-level, well distributed illumination.

SYLVANIA ELECTRIC

MAKERS OF FLUORESCENT LAMPS, FIXTURES, WIRING DEVICES; ELECTRIC LIGHT BULBS; RADIO TUBES; CATHODE RAY TUBES; ELECTRONIC DEVICES

LIKE THE  WASHING MACHINE

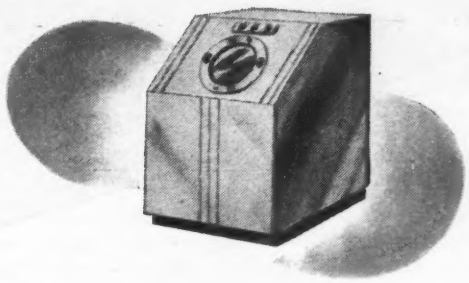
Electrical Raceways



Unlike ordinary threaded conduit, ELECTRUNITE E.M.T. requires no extra metal to act as a base for threads. And because its tight zinc coating is unbroken by threads, ELECTRUNITE E.M.T. provides continuous, lasting protection against rust and corrosion.

With Republic ELECTRUNITE E.M.T., two simple compression-type fittings create positive, water-tight joints in a hurry. And every coupling acts as a union . . . no need to turn the tube to draw up the joint.

have gone modern, too!



CHOOSE REPUBLIC ELECTRUNITE E. M. T.
—The Streamlined Electrical Raceway That's MODERN . . . SAFE . . . DEPENDABLE

Just as the modern automatic washer far surpasses its early forerunners in convenience, so, too, does Republic ELECTRUNITE E.M.T. differ from old fashioned threaded types of electrical conduit.

Here's the difference.

ELECTRUNITE E.M.T. is *threadless.* This modern rigid conduit eliminates dirty, tedious thread cutting. With ELECTRUNITE E.M.T. two simple compression-type fittings and a pair of pliers are all that's needed to make strong, water-tight joints which will not vibrate loose.

ELECTRUNITE E.M.T. is *light in weight.* Because no excess steel is required to act as a base for thread cutting, ELECTRUNITE E.M.T. weighs less than half as much as threaded conduit of the same inside diameter. It goes in faster and easier—especially when the installation is in a "hard-to-get-at" location.

ELECTRUNITE E.M.T. *bends easily.* Inch-Marking—an exclusive ELECTRUNITE feature—greatly simplifies installation problems, and combines with the one-piece ELECTRUNITE Bender to produce quantity bends of predetermined accuracy quicker and easier than ever before.

And ELECTRUNITE E.M.T. meets safety requirements. Inspection by Underwriters' Laboratories, and approval by The National Electrical Code for installation in exposed, concealed or concrete slab construction is your assurance that ELECTRUNITE E.M.T. provides adequate mechanical and electrical protection.

For more information on Republic ELECTRUNITE E.M.T., see your nearest ELECTRUNITE Distributor.

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it's easy to see when it's "Day-Brite"

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marks the beginning of the battle for business—when quality becomes effective ammunition that's easy to use when it's Day-Brite . . . Contractors, Dealers and Wholesalers who would like to profit by this fact are invited to write Day-Brite and learn all the advantages offered by this complete line of fluorescent fixtures.

Consult your nearest Day-Brite Engineering Representative.

The **PARALUME**

(*Pictured above*)

A commercial fixture furnished with two, three or four lights. Suspension or surface mounting. Write for Paralume Bulletin F-50.

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PRACTICAL METHODS

STEEL COWLS PROTECT MOTORS AND CONTROLS

WIRING

The caustic from silver plating solution can be pretty rough on electric motor and control enclosures if they are unprotected. That has been the experience at the Dodge-Chicago Plant, Division of Chrysler Corporation.

When the plant was built, the critical material situation was at its tightest and practical substitutes had to be used in place of equipment items that normally would have been specified. For example: The 1½-hp. motors driving the centrifugal pumps for the filtration tanks through which the silver plating solution passes would normally have been of the totally enclosed, fan-cooled, ball bearing type. They just weren't available so a standard, open type motor was installed.

Knowing that any splashing of the plating solution would cause havoc if it got into the motors, the engineers at Dodge-Chicago devised protective sheet steel hoods which are placed over the motor (Fig. 1). The hood has air vents on three sides to provide sufficient air circulation to prevent overheating of the motor. The normal maintenance routine is not hampered by these protective hoods. All grease fittings have been extended through the hood with ⅛-in. pipe so they are readily accessible to the maintenance man.

Motor control enclosures adjacent to the plating tanks provided another problem. The caustic from any plating solution that might have been splashed on the control enclosures soon attacked and corroded the cases and operating mechanisms—if it got inside. Numerous types of paints were tried in an effort to check this corrosive action without much success (Fig. 2). One type which gave a plastic-like coating worked fairly well at first. But it chipped rather easily and once this occurred the bonding medium between the paint and the metal apparently was destroyed and the coating peeled off in sheet form.

The final solution—and the one that has worked best so far—was the design and installation of a No. 16 gage sheet metal protective cowl over the starting equipment (Fig. 3). The cowl which protects the sides, back and top of the equipment—places where splashing of the solution might be most likely to occur—has rounded edges to prevent injury to operating personnel. It projects several inches over the front of the starters to afford added splash protection. Hinged doors can be mounted to enclosures if desired.

It is acknowledged that whatever paint may be used to cover the cowl might succumb to the inroads of the plating solution caustic. The important feature, however, is that the solution cannot get into the inner workings of the control equipment and, through corrosion of parts, cause a breakdown. It's a lot more simple and economical to repaint a shield than to replace a starter or switch.

FIG. 3—Motor controls after sheet steel cowls were added to protect them from corrosive action of silver plating solution. This anti-splash measure has more than paid for itself in reduced maintenance and extended life of the control mechanism.

FIG. 1—Motor shield protects this standard open-type centrifugal pump motor from attack by splashed solution from this silver plating tank. Adequate vents are provided as well as extended grease fittings to facilitate maintenance.

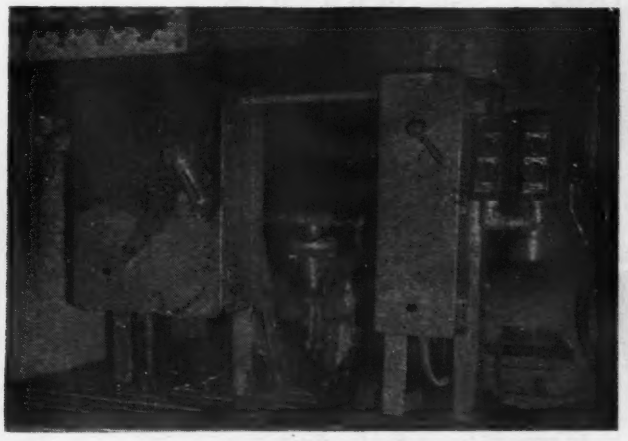
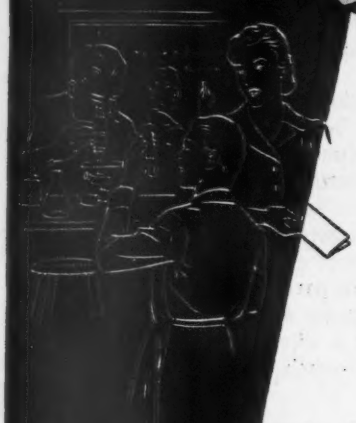


FIG. 2—Motor controls before protective metal cowling was installed. Note the corrosive effect of the plating solution that was splashed on control enclosures. If solution got inside the enclosure, the control unit would be ruined.

it's easy to see when it's "Day-Brite"



EDUCATIONAL ADVANTAGES of Light

Among the many educational advantages actively sponsored by school authorities, architects and engineers, adequate light ranks high on the list—closely paralleled by the quality that's easy to see when it's Day-Brite. . . . With these fixtures contributing the full advantages of light, classroom progress is often accelerated because nervous and mental energy are not consumed in a pointless struggle with poor light. . . .

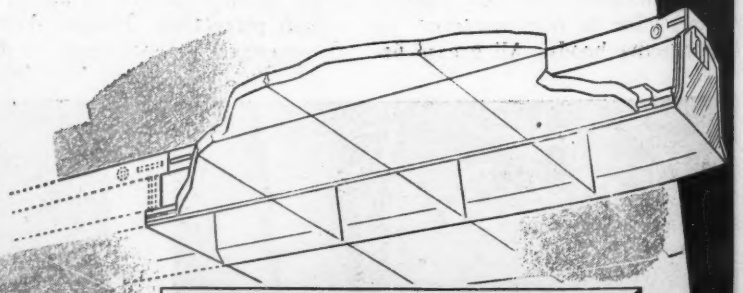
Consult your nearest Day-Brite engineering representative for recommendations. Send for Classroom Lighting Bulletin 50-C.

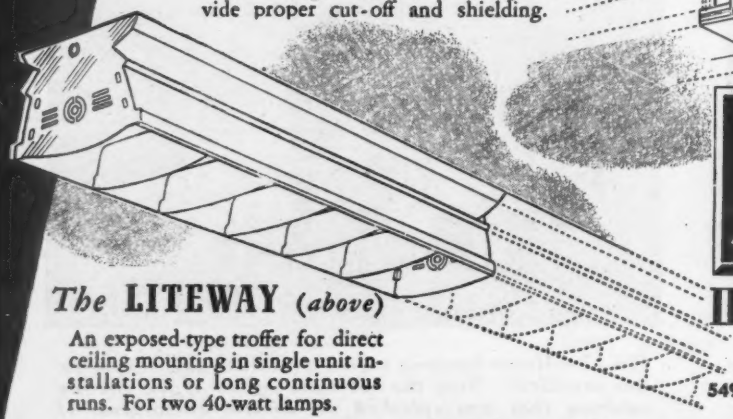
The **VIZ-AID** *(illustrated above)*

Specially engineered to provide additional light output in the useful area of illumination. Designed for two 40-watt lamps, surface or suspension mounting, as single units or in continuous installation.

The **TROFFER** *(right)*

For recessed installations as single units and in continuous runs. For two 40-watt lamps . . . lateral louvers provide proper cut-off and shielding.





The **LITEWAY** *(above)*

An exposed-type troffer for direct ceiling mounting in single unit installations or long continuous runs. For two 40-watt lamps.

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DRYING POWER CABLES

INDUSTRIAL

By R. A. TEN EICK

Senior Electrical Engineer, Power Division Allison Division, General Motors Corp., Indianapolis, Indiana

During the months of industrial expansion immediately following the start of the war, more pressure was often brought to bear upon getting utility equipment installed and operating quickly than upon getting it installed properly. Few plants have been completely immune from the effects of such expediency. As a direct result, many maintenance and operations engineers have found themselves faced during successive years with numerous difficult problems.

One particularly vexing problem encountered about a year ago, and the method used to salvage and return to service the critical material involved, may be of interest to others concerned with the maintenance and repair of underground power cables.

In brief, it was found that 42—200-foot runs of single conductor, stranded, 750,000 C.M., 600-volt V.C. lead sheath cable had been installed between the outdoor transformer station buses and the power plant main 480-volt breakers without the use of potheads or other approved sealing methods at the outdoor ends to prevent the entrance of moisture. The fact that the transformer ends of the underground cables terminated in vertical risers and clamped connections further encouraged the entrance of moisture. Three years of service elapsed before the installation of additional facilities permitted even the temporary removal of the cables from active duty. By that time several runs of one phase had developed ground faults, and the average cold insulation resistance per run of the remaining cables was 100,000 ohms to ground which was considered to be far below any acceptable standard. By way of describing the complete saturation of the cables, it was noted that water dripped from the open ends of the faulted cables when they were cut in the intermediate underground manhole.

It was possible to obtain upon short notice only enough similar new cable to replace the two completely faulted runs. Consequently, it was decided to experiment with a method of drying frequently employed with other types of electrical apparatus. The use of high vacuum in conjunction with heat for drying operations is familiar to most electrical equipment engineers, and it was thought that the same method might be applicable to large stranded cables as well.

By way of experiment, a 100-foot length was cut from one of the removed faulted cables so as to eliminate the actual faulted portion. The piece was coiled, placed in an electrically heated box, raised to about 150°F. temperature, connected by means of piping and clamped hose connections to a two-stage steam jet evacuator, and pulled down to a 28.5 in. Hg. vacuum. Frequent insulation resistance readings were taken over a period of three days. During the first six hours little change was noted. At the end of that period, however, the insulation resistance began to rise with increasing rapidity, finally leveling off at about 200 megohms, thus following a typical drying curve for electrical insulation. After the readings reached steady values of 200 megohms, the heat and vacuum were maintained for another 24 hours. Starting with an insulation resistance of about .0 ohms, the drying process was finished with a cold insulation resistance in excess of 500 megohms, which was considered quite satisfactory for the 600-volt cable in view of its past history.

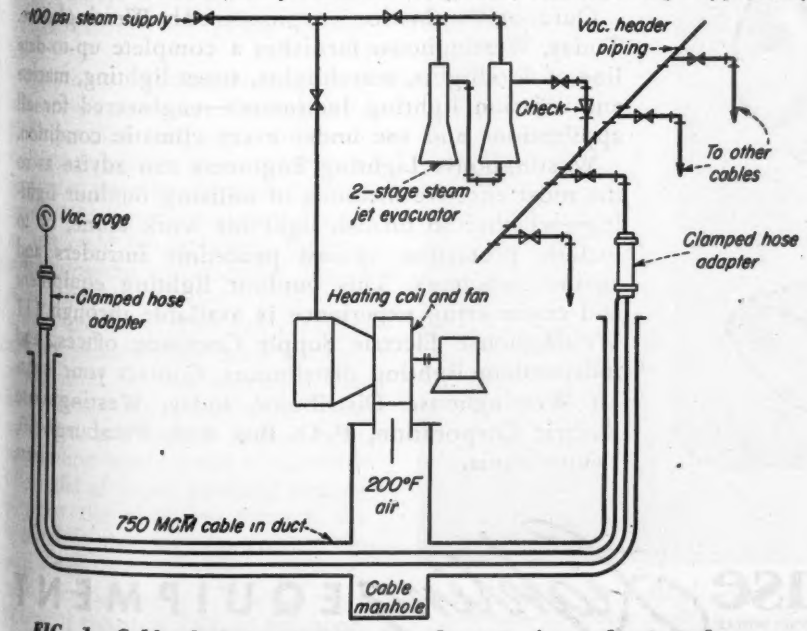


FIG. 1—Cable drying apparatus in schematic form showing the use of steam, vacuum and heated air to dry out underground cables without removing them from their ducts.

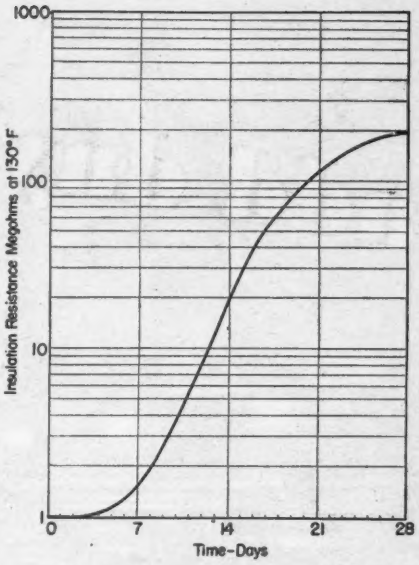


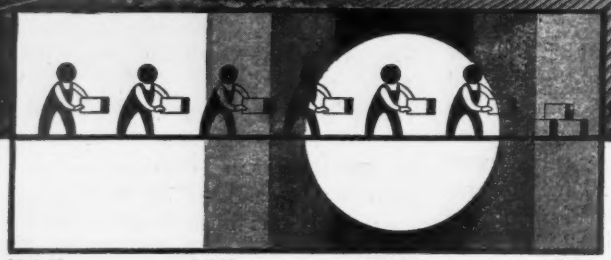
FIG. 2—Typical drying curve showing the rise of cable insulation resistance values as the 130° F. temperature and 28 in. Hg. vacuum were maintained on the cables over a period of approximately 30 days.

Considering the results of the small scale test conclusive, the expenditure of a nominal amount was thought warranted in an attempt to reclaim the remaining 40 cables without removing them from the underground ducts. Heating coils and a high head blower were set up at the intermediate manhole to force 200°F. air through the underground ducts containing the cables. A vacuum header complete with valves and clamped hose adapters was set up at the outside ends of the cable runs. The ends of the cables extending beyond the duct ends, including the vacuum connections, were boxed in and heated to insure drying all parts of the cables. All but two of the remaining 40 cables could be thus held under vacuum, and those two were later pulled from the ducts to disclose faults that had ruptured the lead sheaths and blown partially clear. The remaining 38 cables, assumed to be still intact, were held under heat and vacuum for a period of about 30 days.

Daily insulation resistance measurements were taken with a 500-volt Megger. Following the initial application of heat and vacuum, the insulation resistance per cable run dropped to about 10,000 ohms during the first

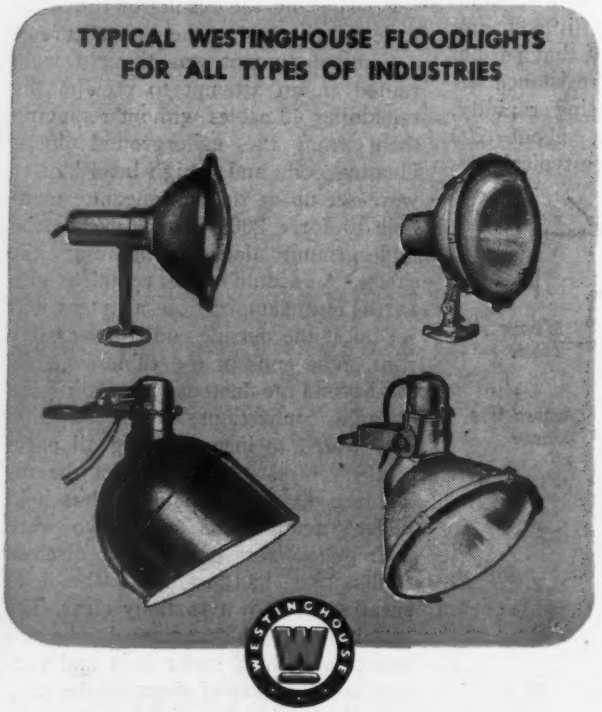
add daylight hours

TO PRODUCTION FIGURES WITH ENGINEERED FLOODLIGHTING



It's never "after dark" . . . outdoor production levels stay high on all shifts—in yards floodlighted by Westinghouse.

This storage yard is crosslighted from banks of two floodlights each, on 25-foot poles along the sides of the yard. Floodlights used were Type VRC-18, each using 1500-watt lamps. Note the light on the three workmen in right center of the picture.



COSTLY slowdowns, accidents and confusion due to darkness can be eliminated effectively . . . profitably . . . by engineered floodlighting. This specialized type of lighting can be applied to most operations normally handled out of doors, to make them equally practical after dark.

Outdoor illumination was pioneered by Westinghouse. Today, Westinghouse furnishes a complete up-to-date line of floodlights, searchlights, street lighting, marine and aviation lighting luminaires—engineered for all applications and use under every climatic condition.

Westinghouse Lighting Engineers can advise as to the most effective methods of utilizing outdoor lighting—whether to furnish light for work alone, or to include protection against peacetime intruders and against saboteurs. This outdoor lighting equipment and engineering experience is available through 117 Westinghouse Electric Supply Company offices, and independent lighting distributors. Contact your nearest Westinghouse Distributor, today. Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-04018

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AVAILABLE THROUGH 117 WESTINGHOUSE ELECTRIC SUPPLY COMPANY OFFICES AND INDEPENDENT DISTRIBUTORS

week. After that there was a daily rise for about two weeks until all cables had insulation resistances of better than 100 megohms at an average cable temperature of about 130°F. The vacuum and heat were maintained on all cables for at least a week after steady insulation values in excess of 100 megohms were first noted, and until the insulation values showed no appreciable tendency to drop when the vacuum was removed.

After drying, and prior to re-exposure to the elements, approved potheads were installed on all cable ends. All were given a potential test of 2000 volts to ground without breakdown and then returned to normal 500-volt service. All cables now have been operating for over a year at full rated ampere load since the drying procedure. The insulation resistance has settled somewhat, probably due to the redistribution of traces of moisture remaining in the cables, indicating that perhaps a still longer drying period at a higher temperature might have been beneficial. Recent tests, however, show that the cables continue to maintain average insulation resistance values in excess of 100 megohms at operating temperatures.

The two-stage steam jet evacuator available was capable of producing an absolute pressure of 0.3 in. Hg., which corresponds to a boiling temperature of 45°F. The boiling temperature might have been further lowered with a three-stage evacuator or laboratory vacuum pump to accomplish more rapid and thorough removal of the moisture. The evacuator used had a bad habit of "backfiring" when steam pressure dropped slightly, necessitating the use of check valves to prevent steam vapor from re-entering the cables at such times.

The project was undertaken in mid-winter when average temperatures of 20°F. prevailed. Naturally this made it all but impossible to raise the temperature of the cables to a point where the rapid drying observed in the original test could be duplicated. During summer months considerably higher cable temperatures could have been attained and more rapid and complete moisture removal could have resulted.

In general, it was concluded that within reasonable limits lower pressures and particularly higher cable temperatures would result in a greater differential of vapor pressure tending to move the moisture through the layers of insulation to the core of the cable where it could readily be evacuated. Considering the nominal overall cost of less than $500.00 for labor, steam, and material involved, the results have proven quite satisfactory.

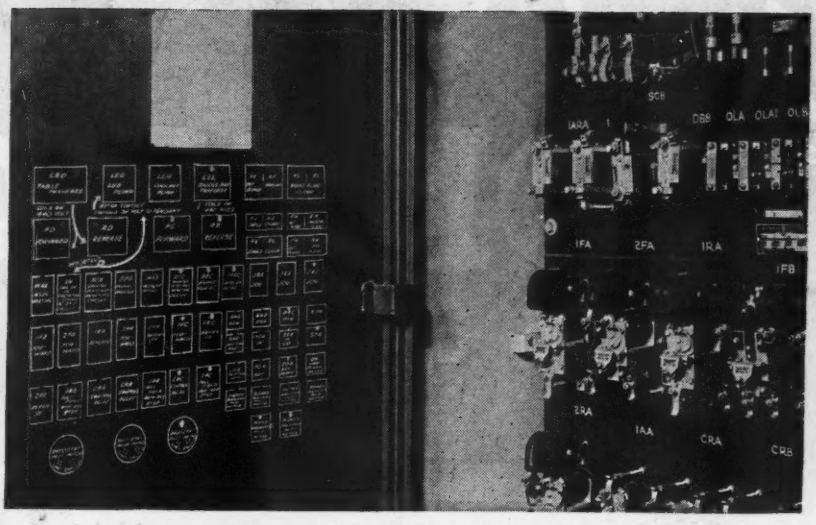


Diagram replica of control positions on 16-motor boring bar control panel (right) painted on the inside of cabinet door. Each rectangle contains identification letters, function of contactor, and color code of back-of-panel wiring and terminals.

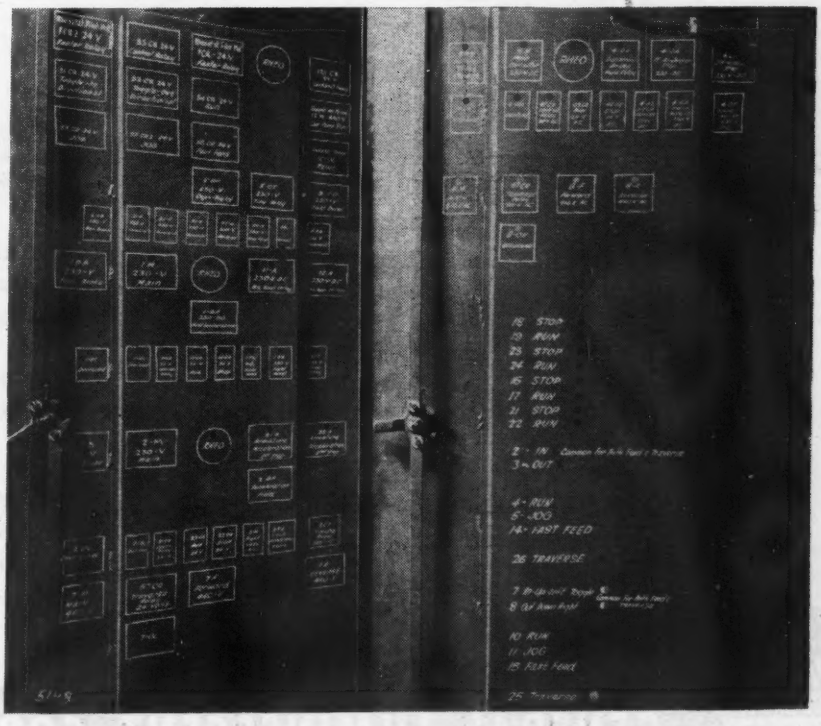
DOOR DIAGRAMS SIMPLIFY COMPLICATED CONTROL MAINTENANCE

MAINTENANCE

Have you ever observed a maintenance electrician who is somewhat puzzled when he encounters a trouble shooting job on a complicated control cabinet? As he attempts to trace the circuits and determine which contactor does what, his mild bewilderment may turn utter confusion. He doesn't enjoy his predicament and the machine still remains out of operation.

With the increased number of inexperienced men working in today's industrial plants, such a situation might be commonplace. But not at the Nordberg Manufacturing Company at Milwaukee, Wis., where diesel engine equipment and other heavy machinery are produced. That is—not if Carl Lau, chief electrician can help it. And he has succeeded in making such a possibility quite remote.

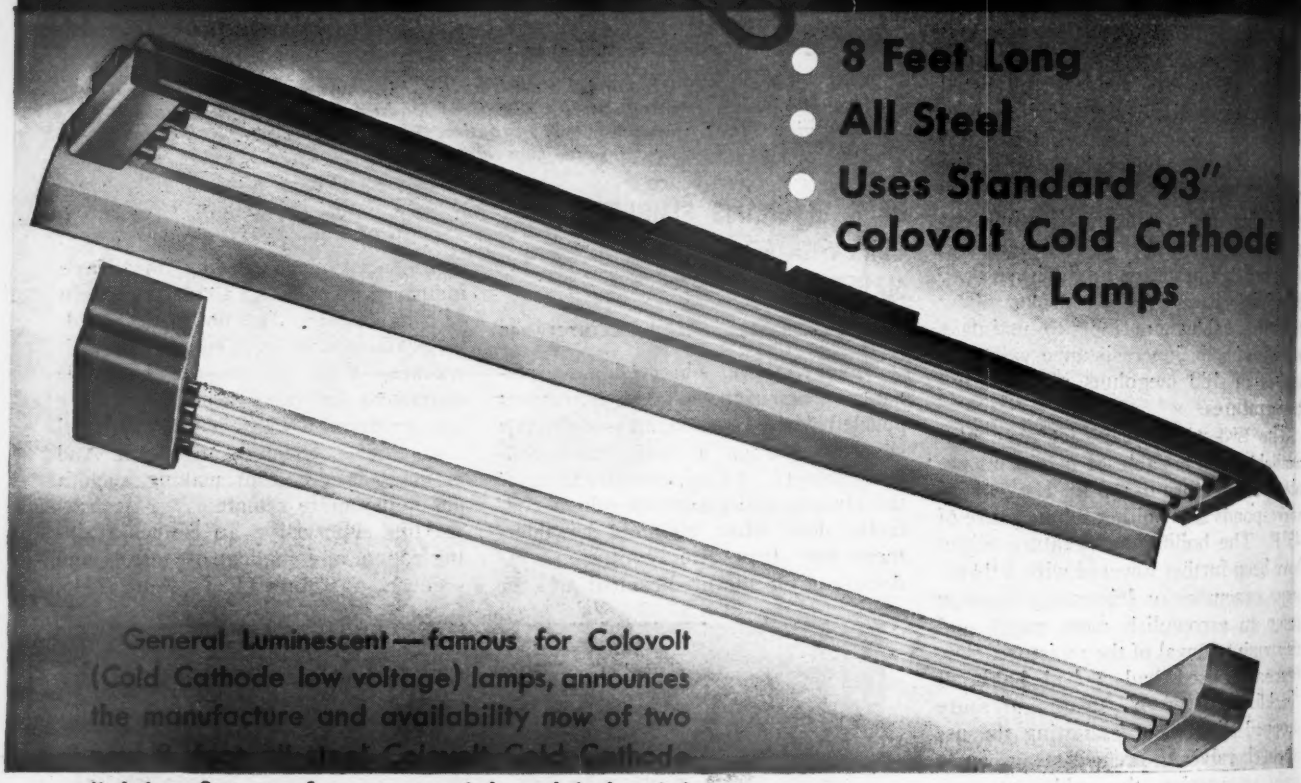
After supervising an 8-week training course in complicated controls and sequence operation (E. C., April 1945,



A glance at these diagrams on the inside of cabinet doors on a complicated 13-motor milling machine control cabinet and the maintenance electrician can quickly spot the position and function of each piece of equipment on the face of the panel. This is proving to be a considerable time saver on maintenance work.

Now! *COLOVOLT

COLD CATHODE FIXTURES



- 8 Feet Long
- All Steel
- Uses Standard 93" Colovolt Cold Cathode Lamps

General Luminescent—famous for Colovolt (Cold Cathode low voltage) lamps, announces the manufacture and availability now of two [illegible] lighting fixtures for commercial and industrial applications in a standard "packaged" unit.

Both of these fixtures use standard 93" Colovolt 10,000 hour lamps and can be used singly or in continuous line lighting in multiples of 8 feet. Instantaneous starting, no flickering, guaranteed for 1 year except for failure due to breakage, and the fact that the long life expectancy of Colovolt lamps may be realized even when constantly turned on and off, are additional advantages.

Contact your electrical wholesaler or jobber or write us for full details.

Above

INDUSTRIAL UNIT—The Industrial Fixture, designed to give the maximum of lighting efficiency has an all-steel 8-foot baked white enamel reflector which is easily removed for cleaning. Four lamp fixture delivers 8800 lumens. Also available in a two-lamp fixture.

Below

SIMPLICITY UNIT—The "Simplicity" Lighting Unit for commercial uses is distinctive in design, easy to install and simple to maintain. This 4-lamp fixture delivers 8800 lumens.

* Trade Mark registered U. S. Pat. Off.

General LUMINESCENT CORPORATION

GENERAL LUMINESCENT CORPORATION

672 SOUTH FEDERAL STREET • CHICAGO 5, ILLINOIS

pg. 76), he went one step farther and had every contactor on these control panels clearly identified and labeled. To make things easier for his crew, he had drawn on the inside of the cabinet door a number of squares and rectangles, each representing a control contactor on the panel in the cabinet. In each rectangle is printed the identification letters corresponding to the ones painted under the contactors on the face of the panel; also the function of that particular contactor. Added to this is a color code. A dot of colored paint is dabbed in the rectangle and on the *back of the panel* leads and terminals of the corresponding contactor. Sometimes a dab is added to the contactor itself on the front of the panel.

The position of each rectangle on the cabinet door corresponds to the actual panel position of the contactor it represents. Thus, when an electrician looks at the diagram on the cabinet door he is really looking at condensed facsimile of the control panel. The manufacturer's wiring diagram is mounted to the door just above the painted diagrams.

This may appear to be a lot of work that may not justify the effort expended. Not so. Experience at Nordberg has definitely indicated that this feature has been of inestimable help to the maintenance electricians. They no longer approach an interlocked sequence trouble shooting job with trepidation and shutdown repair time on such machines has been effectively reduced. This feature is a definite part of the maintenance educational program in effect at the Nordberg plant.

ELECTRICAL SENTRIES ON DRYING OVEN APPROACH

WIRING

The initial step in making the castings for the various metal parts that go into a B-29 engine is the preparation of the molds. Once the molds have been formed they are sprayed with a liquid preparation designed to "set" the compacted sand and then passed through a long drying oven. An unevenly loaded conveyor basket can cause considerable trouble, particularly if there are any turns to be traversed in the oven interior.

To eliminate the possibility of any "oven jams" in the magnesium foundry at the Dodge-Chicago Plant, Division of Chrysler Corporation, the plant engineers have installed limit switches as sentries at the spray dry oven approach. Now, when a conveyor basket —a large metal frame with four shelves on which the molds are placed

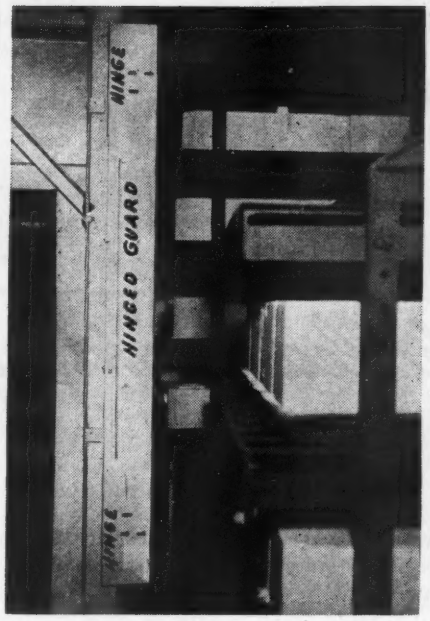


FIG. 1—Hinged guards actuating limit switches prevent unevenly loaded conveyor baskets from entering spray dry tunnel at Dodge-Chicago Plant's magnesium foundry. Tunnel jams have been entirely eliminated.

—is unevenly loaded and tends to swing or ride "off-center" it will strike one of the guards actuating the limit switch on either side of the even approach and stop the conveyor.

One of these guards is shown in Fig. 1. It consists of a long narrow piece of sheet steel flanged on one side (that facing the conveyor baskets) and hinged to a supporting steel column. The hinges are mounted so the guard pivots about an axis just off center of the guard width (See Fig. 2). Long slots at the hinge bolts permit horizontal adjustment of the guard to provide proper clearances for the conveyor baskets. Contacting the back of the metal guard about midway along its length and near the unflanged edge, is the roller arm of the conventional limit switch. Retention springs keep the guard always at right angles to the column on which the limit switch is mounted. While in this position, the arm of the limit switch is pressed down completing the control circuit of the conveyor motor and normal operation takes place. An angle-iron stiffener mounted to the face of the guard between the hinges keeps the unflanged edge from buckling at the point of contact with the limit switch arm.

A clearance of approximately 2¾ inches is maintained between each guard flange and the outer edges of the conveyor basket. If the conveyor is properly loaded, it will pass through these guards without touching them and have a safe passage through the entire drying tunnel.

If the basket should be unevenly loaded and approaches the oven entrance with a slight overhang (off-center) one of the basket platforms will strike the flanged edge of either the left or right hinged guard. When this happens, the guard will pivot inward—the flanged edge following the direction of conveyor travel. The unflanged edge of the pivoted guard will swing outward against the tension of the springs, relieving the pressure on the limit switch arm which then breaks the control circuit and the conveyor motor stops. The molds on the out-of-line basket can then be shifted so it will hang plumb and the conveyor motor can again be started.

As an additional safety feature, there are no remote stations from which the conveyor motor can be started. The conveyor will not start immediately when the guard returns to the normal operating position. The operator must go back to the motor switch to start the line in operation again.

The installation of these limit switches has completely eliminated "oven jams" at Dodge-Chicago Plant's magnesium foundry. Molds for castings now flow smoothly through the long ovens. Off-center baskets automatically stop the conveyor belt until properly adjusted.

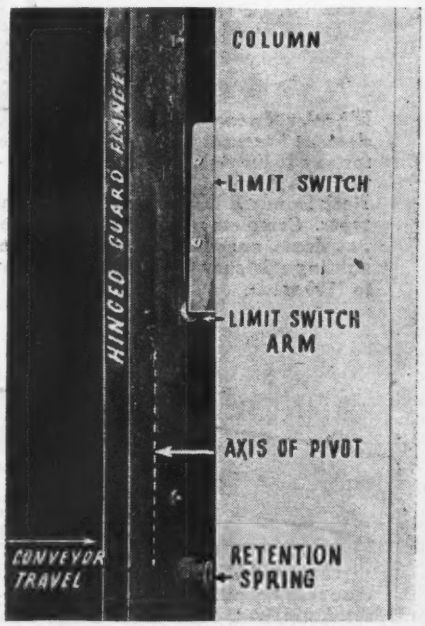


FIG. 2—Back-of-guard view showing details of limit switch arrangement. When an off-center basket hits flanged edge, the hinged guard swings to the right pivoting about the axis of pivot (dotted line). The unflanged edge moves to the left against pressure of the retention springs thus releasing pressure on limit switch arm and opening control circuit of conveyor motor. Retention springs return guard to original position, but conveyor motor must be started at motor switch.

THE REFLECTOR IS THE BACKBONE
OF ANY LIGHTING SYSTEM

It Costs No More To Get

Skilled Lighting

When you get going on those war-delayed renovations in plant lighting, why not make sure that the system you install will be a *permanent plant improvement?*

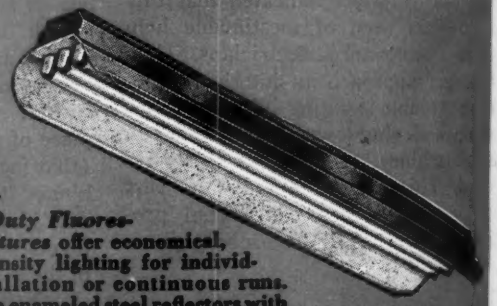
A high-intensity lighting system equipped with Wheeler Fixtures costs no more than other modern systems, yet it gives you Skilled Lighting that pays dividends in high worker-output, improved product-quality, lower accident rates and better morale *for years to come!*

Wheeler Lighting is *skilled lighting* because it's designed with the know-how and vision of engineers who have specialized in good lighting for more than 60 years. It is quality equipment . . . built to highest RLM standards of construction, durability and light-output.

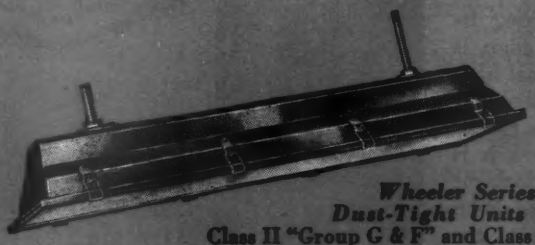
Write for details of Wheeler's complete line of Incandescent and Fluorescent Fixtures for industries. Wheeler engineers will be glad to help you plan correct layouts. **Wheeler Reflector Company, 275 Congress Street, Boston 10, Mass.** Also New York. Representatives in principal cities.

DISTRIBUTED EXCLUSIVELY THROUGH ELECTRICAL WHOLESALERS

Wheeler Incandescent Fixtures for any industrial use. RLM Solid Neck Standard Dome is only one of many types. Complete range of standard shapes . . . dome, angle, etc. Provide maximum lighting efficiency for lamps from 75 watts to 1500 watts.



Wheeler Heavy Duty Fluorescent Fixtures offer economical, high-intensity lighting for individual installation or continuous runs. Porcelain enameled steel reflectors with high reflection efficiency. Made for two 40-watt, three 40-watt and two 100-watt lamps.



Wheeler Series II Dust-Tight Units for Class II "Group G & F" and Class III and IV Hazardous Locations. Hinged cover protects lamps from dust and vapors. Supplied with Double-Thick Plain Clear Glass, Water-White Plate Glass or Tempered Clear Safety Plate Glass.

Wheeler Vapolux Reflectors for incandescent lighting in hazardous locations. Dust-tight and vapor-proof . . . highly durable and easy to install and service. Made in standard styles for lamps from 100 watts to 500 watts.

Wheeler REFLECTOR COMPANY

LIGHTING EQUIPMENT SPECIALISTS SINCE 1881

DATA SHEET

The number at the right is a classification for convenience in filing and for a future data sheet index

XTI

Transformer Installation

(including mezzanine platform for unit)

BUILDING CONSTRUCTION:

Fireproof modern office building; pan construction; ceilings 10'–0" above finished floor.

NATURE OF JOB:

A new 75 kva. transformer was to be installed and paralleled with an existing bank of similar units at several meter closet locations to increase electric service capacity at specified locations throughout the building. Service in the building was 480-volt and all lighting was fed by 480/240/120-volt transformers. The labor data contained herein deals only with actual mounting of the transformer units and does not include connecting the transformers.

JOB CONDITIONS:

The additional transformers, of necessity, had to be installed in the existing meter closets which already housed the existing units. Space was at a premium and the metering closets could not be extended without interfering with tenant occupancies. To permit setting the new transformer directly over the existing unit, it was decided to construct a steel shelf and supporting framework which saddled the old transformer.

The outside legs of this mezzanine platform consisted of two 6-inch channel iron sections, each long enough (10'–0") to extend from the floor to the ceiling. A heavy steel strap, securely anchored to the ceiling, acted as a spacer between the channel iron uprights as well as an anchor. At the floor line, the uprights were anchored by a 3"by 3"angle iron toe piece welded to the flat sides of the channels. Angle iron ties welded to the channels supported the transformer platform. Supporting angles (braces) were also welded to the channel uprights.

All steel work was pre-fabricated, but welding was done on the job.

When in the place on the platform, the new transformer top nearly touched the ceiling. The only means of hoisting the transformer into place was to break a hole in the floor immediately above the transformer location and set up the hoist on the floor above, dropping the chain hook through the hole. Thus the unit could be hoisted all the way to the ceiling and swung over on the platform proper.

Receiving and transportation of the steel and transformer units presented no problem. Loading dock facilities, elevators and freight isles were available and could be rated ideal.

LABOR ANALYSIS:

The labor data presented in column two of the above table is the average recorded on six typical metering closet installations. This is considerably below what would be estimated (and required) for a single installation as shown in column one (*) of the table. There is considerable planning, field engineering, etc., that must be written into the job labor. When there are several typical installations involved, the field engineering and supervision per unit is relatively small and can be covered by the job overhead. But it becomes too large an item to be covered as job overhead on a single installation, hence it is included in the labor making the units in column one of the table considerably higher than those of column two (which does not include this extra labor).

The initial setup and planning results in considerable wasted time. A minimum of three men would be used and until a system was devised there would be a substantial amount of non-productive labor.

LABOR DATA

Type of Work Done	Total Man-Hours: For one setup*	Total Man-Hours: Average of six installations
Receive, transport and erect steel framework—complete	10.0	6.0
Receive 75 KVA. transformer (1200 lbs.), unload from delivery truck to loading dock, place on hand truck and uncrate	6.0	2.5
Move transformer into building elevator and roll to job location—average distance, 150 feet	4.0	2.5
Install steel tripod on floor above the transformer location, break hole in the 3-in. concrete floor, set up chain hoist, and hoist transformer to platform	15.0	12.0
Patching by others:	....	....

Note: Column one (*) for a single installation has much higher labor units. See Labor Analysis discussion for explanation.

LABOR CLASSIFICATION:

Two "A" men; one "B" man used on the job.

The types of available labor are rated A-B-C-D-E, with the units based upon average use of B labor. In general, an A man will run the job assisted by B and C labor, which will average class B. In abnormal times the general labor classification will fall to D and E for new labor being employed to fortify the regular personnel. It must be noted that the classification applies only to rate of time and not to knowledge or mechanical ability. A splendid mechanic may be rated C from a rate of time classification.

Labor Classification	Changes in Standard Units
A	deduct 10%
B	no change
C	add 10%
D	add 20%
E	add 30%

The labor classification shown in the estimating data above shows the labor classification rating of the mechanics who performed the particular job so that adjustment can be made on the type of labor available.

DETAILS OF PLATFORM installed over existing transformer to support new unit directly above.

Data from L. W. Witz, Continental Electrical Construction Co., Chicago, Illinois.

a preview of the BENJAMIN 3-year program

for BENJAMIN distributors and electrical contractors

THE reconversion and modernization of industrial plants, commercial and service establishments offer exceptional opportunities for the sale and installation of lighting equipment over the next three years. Nevertheless, lighting equipment will be in competition with many types of non-electrical products which industrial and commercial customers want and need.

Therefore, intensive selling and promotional effort is required. To meet this need, the Benjamin 3-year program has been developed to enable you to best demonstrate to customers the advantages obtainable from good lighting and from the installation of Benjamin lighting equipment.

Product Development

Benjamin will continue to provide a complete line of industrial lighting units designed in accordance with all recognized

Markets: Benjamin plans Aggressive Cultivation of these Markets

Industrial

From its beginning, the Benjamin organization has specialized in industrial lighting. It will continue to cultivate this field intensively and aggressively, taking advantage of the tremendous potential existing in the relighting and improved lighting of large and small industrial plants during the reconversion and post-war period. Utilities, electrical contractors and Benjamin distributors will be provided with direct mail campaigns and other promotional material to reach all specifying and influencing factors in industry. We will also continue to offer an expanded line of industrial incandescent and fluorescent units to meet every industrial requirement.

Gasoline Service Stations

Benjamin has led in the promotion of floodlighting and other lighting for gasoline service stations, parking places and other roadside commercial establishments. It pioneered in the opening up of a vast new lighting market through its announcement, in 1930, of the Benjamin Duo-Service Floodlight followed by other open and closed type floodlights. In the expectation of greatly increased automobile travel these establishments are now planning for the modernization of their facilities. In order that lighting may be given fullest attention the Benjamin program includes a series of direct mail campaigns. One of these is now in preparation and will be available in the last quarter of the year.

Offices, Schools and Stores

Work and service areas and laboratories of offices, schools and store buildings have always constituted a substantial market for Benjamin lighting units. New fluorescent lighting units designed to provide adequate lighting for offices, schools and stores are now under development and will be available as soon as facilities now used for essential war production become available for the production of this equipment.

These units, in every respect, will be built to the Benjamin standards of quality which, through the years, have made the Benjamin trade-mark a nationally recognized symbol of uniform quality, efficient design and an extra safety factor of strength and durability.

Service Establishments

This field includes such service establishments as laundries, dry cleaners, service garages, bakeries, printers and other similar local industries again in a position to have new lighting equipment installed. Special programs for reaching these markets are now under development and will be announced in the fall of 1945.

Sports and Play Areas

Benjamin was one of the leaders in promoting the lighting of softball fields and football fields. The Benjamin Line will be expanded to take advantage of the increasing interest in the lighting of night sports. There will again be available a complete set of sports lighting data sheets and promotional material to help develop this market.

Farms

Benjamin was one of the pioneers in providing various types of lighting equipment for the interior of farm buildings and for the outdoor work areas. Benjamin plans provide for new types of equipment to serve this field and new merchandising programs which will be helpful to all those who serve this expanding field.

industry standards and performance recommendations. Utility, Alzo-Lite, and Duo-Service Floodlights and most other items which were catalog-marked "Temporarily Discontinued" during the war are being reinstated and again will be available in 1946. Reflector efficiencies, sockets and other accessories will continue to be improved, and new, specialized equipment added as required. Further, in 1946, there will be made available new Benjamin commercial fluorescent lighting units designed to meet the specific requirements of offices, schools and stores.

New Benjamin Research and Testing Laboratory

To provide additional facilities for such product research and for continued quality control of all Benjamin production, construction will be started this year on a new laboratory building with complete facilities for electrical, photometric and acoustical testing. Included will be a conference room and facilities to demonstrate the various Benjamin products to the visitors which we expect to welcome to our plant.

On the roof of the laboratory building will be a weathering tower which will be used to make weather tests of various types of Benjamin floodlights and other outdoor lighting equipment and of various porcelain enamel products.

Preview of Market Development and Promotion Plans

Summarized below are the principal markets toward which Benjamin will direct its efforts of producing lighting equipment. Also outlined is the three-year sales development program designed to complement and support your own sales program and to be integrated with existing and future industry programs. We commend this outline to your attention and cordially invite your suggestions.

Benjamin Electric Mfg. Co., Des Plaines, Illinois

Promotion: a Preview of Benjamin's 3-year Sales Promotion Program

Product Information and Application Data

Number one on the Benjamin program is to place into the proper hands adequate data needed to select, specify, install and purchase Benjamin lighting equipment. There will be available new catalogs, new specification sheets, a constant flow of lighting data sheets and other application data. All these are in modern dress, styled and designed for quick and easy use.

Sales Training

Benjamin field engineers located in principal cities throughout the United States will be prepared to cooperate in sales training activities and to provide the necessary product information, samples, visual sales helps and other assistance. Available, too, will be the know-how which comes from years of practical experience in the solution of all types of lighting problems with Benjamin lighting equipment.

Direct Mail & Printed Matter

In preparation now are direct mail campaigns which may be used by utility sales departments in promoting better lighting in industrial plants, gasoline service stations and other similar establishments. Under preparation also is a new Scrap Book of Postwar Improvement Suggestions for gasoline service stations, and other automotive service establishments, "A Guide to Modern Factory Lighting Practice," "A Guide to More Lighting Sales" and other booklets, folders, etc.

Exhibits and Displays

The Benjamin plan provides for full cooperation and participation in the various exhibit and demonstration lighting activities in which lighting is a feature or related subject. Exhibits will be designed to educate industrial and commercial customers on the advantages of better lighting and the benefits of installing only lighting equipment designed in accordance with recognized industry standards.

"Lighting Review & Digest"

Published as a contribution to the advancement of lighting practice and lighting sales methods, this quarterly review of current articles on trends and progress in lighting and of new developments in the science of seeing will be expanded. Its circulation will continue to be restricted to electrical contractors, electrical men of larger industrial plants, architects and consulting engineers, lighting sales and lighting engineering personnel of utilities, lamp companies and distributors who request copies.

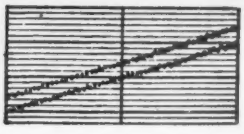
Magazine Advertising

An expanded schedule of Benjamin advertising in leading industrial, architectural, business and electrical publications will continue to sell better light for better sight, the importance of soundly engineered lighting and of properly designed equipment for maximum service. A folder showing reprints of the current series of advertisements is available to you upon request.

Benjamin Lighting Equipment is Distributed Exclusively through Electrical Wholesalers

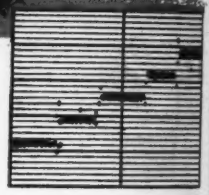
How to Check a Watch's Accuracy to 0.001% with RCA Electron Tubes

Electronic "WatchMaster," manufactured by American Time Products, Inc., New York City, uses RCA electron tubes to record watch-rate within 0.001% in only 30 seconds



This watch is running 60 seconds fast.

This watch is running 60 seconds slow. It has an eccentric escape wheel.



This watch is running 90 seconds fast. It has a defective escape tooth.

Before the Watch-rate Recorder was available, a week or more was required to adjust and time a watch. Moreover, watchmakers had to guess at causes of trouble.

THE ELECTRONIC METHOD—American Time Products' engineers developed an electronic method of measuring and permanently recording the rate of a watch. Seconds fast or slow are determined by comparison with a fixed frequency standard or time scale.

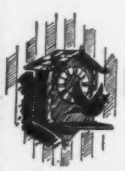
HOW IT IS DONE—The tick of the watch is picked up and amplified by a pair of RCA 6SJ7 tubes. The amplified tick controls an RCA-2050 thyratron tube, which energizes a stylus to make a dot on a revolving chart driven by a synchronous motor. Each dot on the chart corresponds to a single tick. If the watch is keeping correct time, the dots form a straight line across the chart. If the watch is fast, this line slopes upward; if slow, it slopes downward. The chart is so calibrated that a 30-second recording shows the timekeeping of the watch in minutes and seconds per day. The character of the pattern also indicates mechanical imperfections of the watch, such as worn pivots, lack of lubrication, eccentric balance wheel, defective escapement, and other irregularities.

The frequency standard or timing base in the WATCHMASTER is a special-alloy, compensated tuning fork, which has an accuracy of at least 0.001%. The fork energy is amplified by RCA tubes so that the output from an RCA 6L6G drives the synchronous motor that rotates the drum holding the chart paper at exactly five revolutions per second. This corresponds to the 5-tick-per-second rate of the ordinary watch. The tubes required are all low-price standard tubes available from any RCA dealer.

ADVANTAGES—Any watch not requiring replacement of parts or repair can be completely and accurately adjusted in two or three minutes—saving nearly a week's time for each watch. The adjustments are scientifically exact and do not require the services of a skilled watchmaker. Watches can be adjusted while the customer waits, and a visual record, in the form of a chart, can be delivered to him as evidence of the accuracy of his watch. If extensive repairs are shown to be necessary, the customer has evidence of this in the chart.

APPLICATIONS—The basic principles underlying the performance of the WATCHMASTER are applicable to any timing and control problems where high accuracy and short-interval timing are important. For example, a chronograph has been developed by American Time Products, Inc. that records time-intervals of several minutes to an estimated 0.001 of a second. Shaft speeds can be determined either stroboscopically or through calibration of tachometer equipment. Synchronous-motor speeds may be maintained accurately by direct drive or by means of auxiliary control. Secondary-frequency standards, useful in any general or research laboratory, can be manufactured to any practicable degree of accuracy.

TURN TO ELECTRONICS FOR SOLUTION OF YOUR OWN PROBLEMS — Electron tubes are providing a practical solution to hundreds of diversified manufacturing problems — process-control, machine-control, heat-treating of metals, plant-protection, and a host of others. Consult with RCA tube-application engineers for information or advice on the application of electronic tubes in your own plant. For examples of present day uses of electron tubes in industry, send for a copy of the free booklet "16 Examples of Electron Tubes at Work in Industry." Write to RCA, Commercial Engineering Department, Section 62-59S, Harrison, N. J.



BUY BONDS BUY BONDS

THE FOUNTAINHEAD OF MODERN TUBE DEVELOPMENT IS RCA

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TUBE DIVISION · HARRISON, N. J.

PRACTICAL ARTICLES on the application, installation and maintenance of electronic apparatus in industry. Readers are invited to contribute items from their experience to this department. Articles used will be paid for.

ELECTRONICS

Maintaining and Servicing Sealed-Ignitron Rectifiers—II

By L. W. Morton
Industrial Engineering Division
General Electric Company
Schenectady, N. Y.

ALTHOUGH Part I of this three-part article described sealed-ignitron rectifier equipment in some detail, it is good practice for each maintainer to familiarize himself more completely with the equipment under his care by studying all the literature supplied by the manufacturer relating to this equipment. In addition, it would be helpful for him to read any other educational material available. A brief bibliography of pertinent technical literature will be given at the end of Part IV of this article.

He will find it very helpful to study the blueprints supplied with the equipment, particularly the elementary wiring diagrams. Many maintainers commit important parts of these diagrams to memory, so that they can inspect the apparatus and locate troubles quickly without a time-consuming study of the diagrams.

An inspection chart, for guidance, should also be one of the maintainer's tools. The accompanying inspection chart is designed for that purpose. It is based on daily, monthly, and annual programs of preventive maintenance which should successfully meet the requirements for average installations. In compiling this chart it was assumed that the rectifier equipment was kept in continuous operation. Many other such factors, as well as local conditions, may influence the frequency of inspection. Obviously, when dirty or gassy conditions exist, more frequent cleaning and inspection are imperative. The schedule will also depend upon the amount of load and degree of service reliability required. All this adds up to the fact that the maintainer is urged to exercise good judgment in applying the suggestions contained in this inspection chart, particularly as to the frequency of the inspection programs.

The Practice of Preventive Maintenance For The Rectifier Component

The inspection chart outlines what to inspect and what to look for, covering all components of the equipment. However, as mentioned earlier in this article, it is assumed that the maintainer will have available from other sources all the necessary descriptive material and recommendations covering the a-c and d-c switchgear and transformers. The remainder of this installment will, therefore, contain suggestions covering the details of how to take care of the various parts of the rectifier component of the equipment. These suggestions will cover what has to be done by the maintainer when he carries out the itemized inspection work under "What to Look For" on the chart.

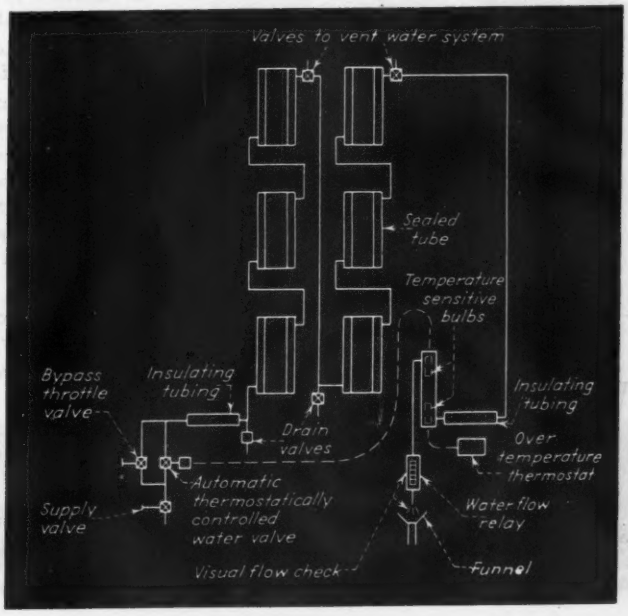

FIG. 1—Type 1 (a) Direct raw water cooling system used with six sealed ignitron tubes.

How To Take Care Of The Cooling System

There are three types of cooling systems in common use with sealed ignitron rectifier.

1. *Direct Raw Water Cooling* (The raw water is discharged to the sewer).
   (a) The raw water circulates through the tubes under pressure from a tap water system and the amount of water is controlled by either a manual throttle valve or by an automatic thermostatically controlled valve (Fig. 1).
   (b) Raw water is circulated

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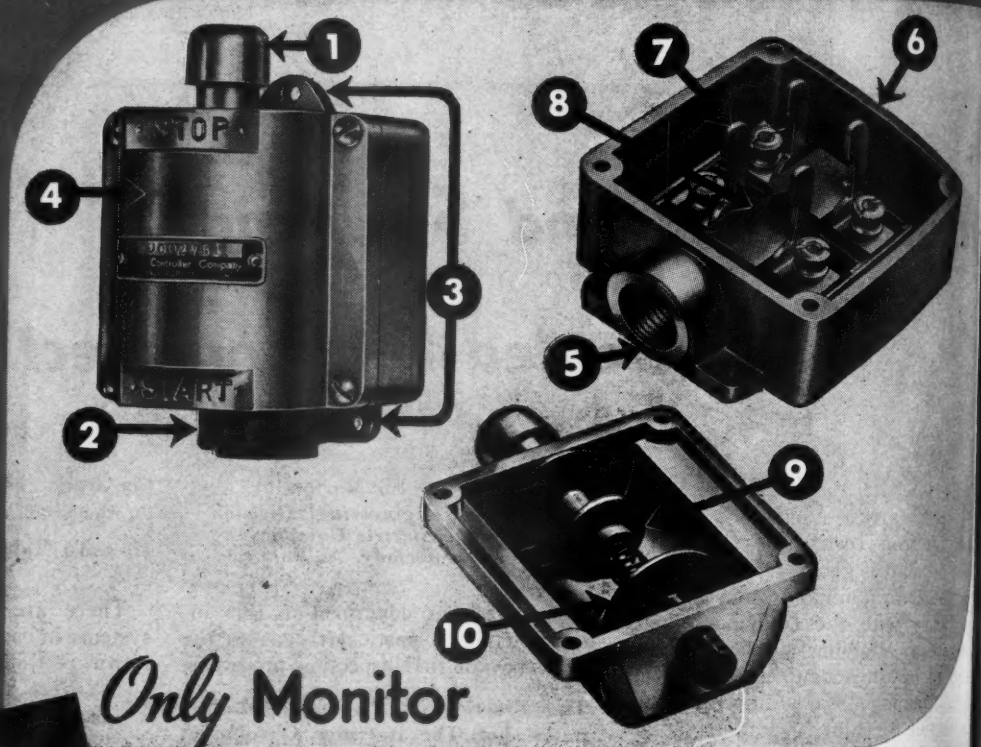

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through the tubes at a constant rate by an auxiliary motor driven water pump. A mixing tank is used, and some desirable range of water temperature through the tubes is held by regulating the amount of fresh raw water entering the mixing tank. Usually the flow is controlled by means of a manual throttle valve or an automatic thermostatically controlled valve (Fig. 2).

2. *Water-to-Air Heat Exchanger*—A coolant, which may or may not be treated with rust inhibitor or anti-freeze, is circulated through the tubes and a surface air-cooler by an auxiliary motor driven water pump. The losses are removed from the surface air cooler by a motor driven blower (Fig. 4).

3. *Water-to-Water Heat Exchanger*—A coolant, which may or may not be treated with rust inhibitor, is circulated through the tubes and a water-to-water surface cooler by an auxiliary motor driven water pump. The losses are usually removed from the water-to-water surface cooler by passing raw water through the surface cooler under pressure from a tap water system, and the amount of water is controlled by either a manual valve or an automatic thermostatically operated valve (Fig. 3).

Checking Water Flow in Direct Raw Water Systems

If direct raw water cooling is used, it usually is discharged to the sewer after passing through the rectifier. Generally arrangements are made at or near the point of discharge for visual inspection of the water flow. This arrangement may be an open funnel at the sewer connection into which the discharge water goes, or a sight gage in the water piping where the water can be seen. Some rectifiers are equipped with water flow relays which have calibrated sight gages. Then the rate of water flow can be quickly checked (in gallons per minute) by reading this gage. Therefore, when direct raw water cooling is used, the quick way to make the daily water flow inspection is to check it visually.

Type 1 (a) (Fig. 1) raw water cooling systems are nearly always equipped with water flow relays which should be set to trip the rectifier off in case of too little cooling water. Sometimes these relays become inoperative, failing to trip the rectifier when water fails. The cause is usually incrustation, sedimentation, or debris in the water passages of the relay. When the maintainer finds water conditions that tend to cause such clogging of the relay, he should disassemble and remove this material frequently enough to prevent failure of the relay. The simplest way to test the operation of the flow relay is to cut off all water to the rectifier by momentarily closing the supply valve. This should cause the relay contacts

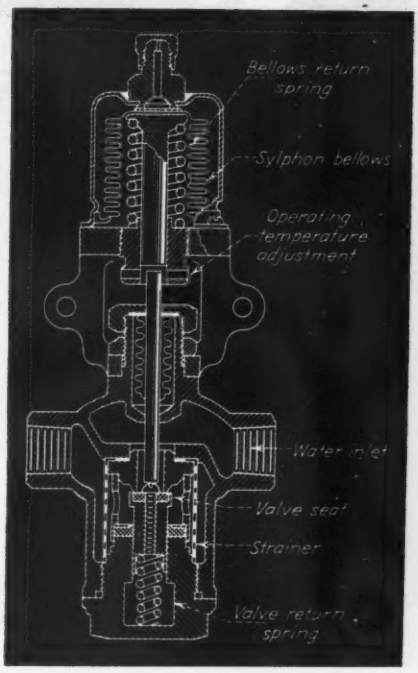


FIG. 3-A—An automatic water valve.

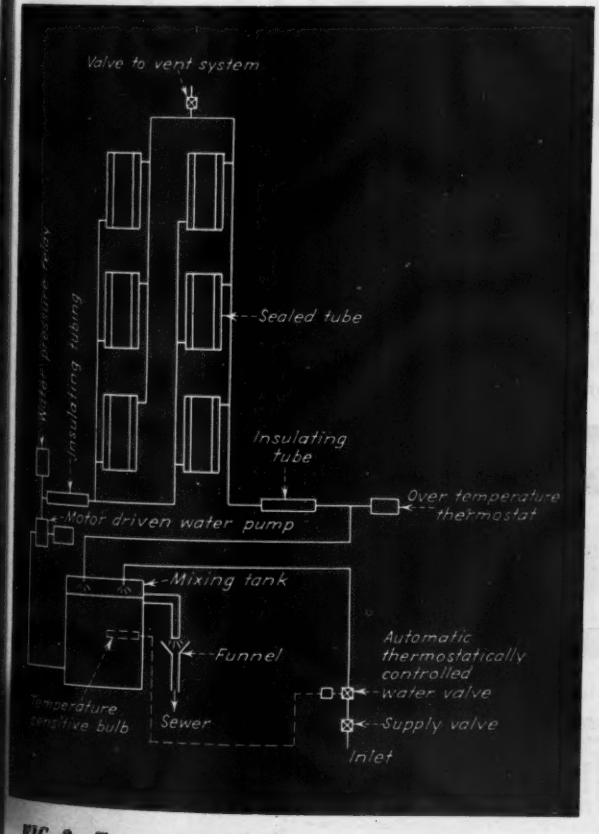


FIG. 2—Type 1 (b) Direct raw water cooling using mixing tank for six sealed ignitron tubes.

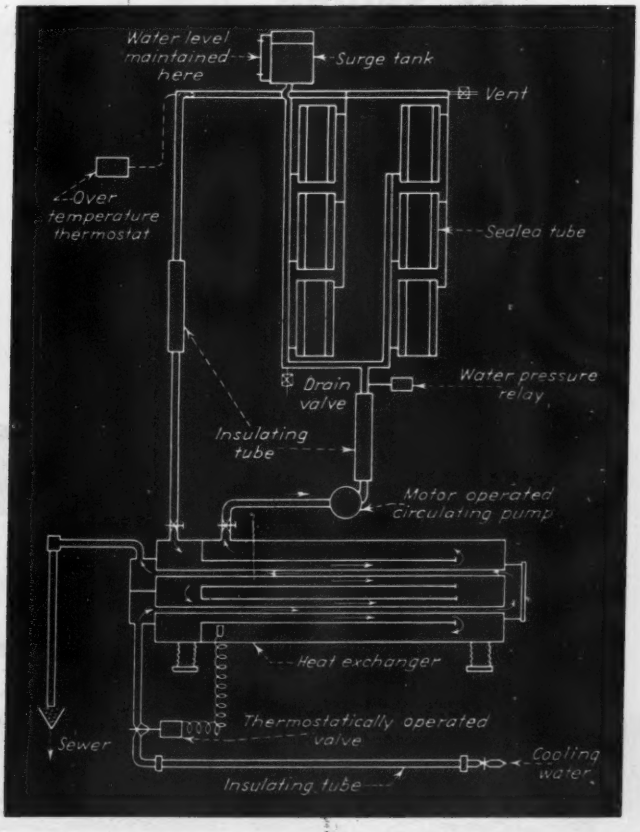
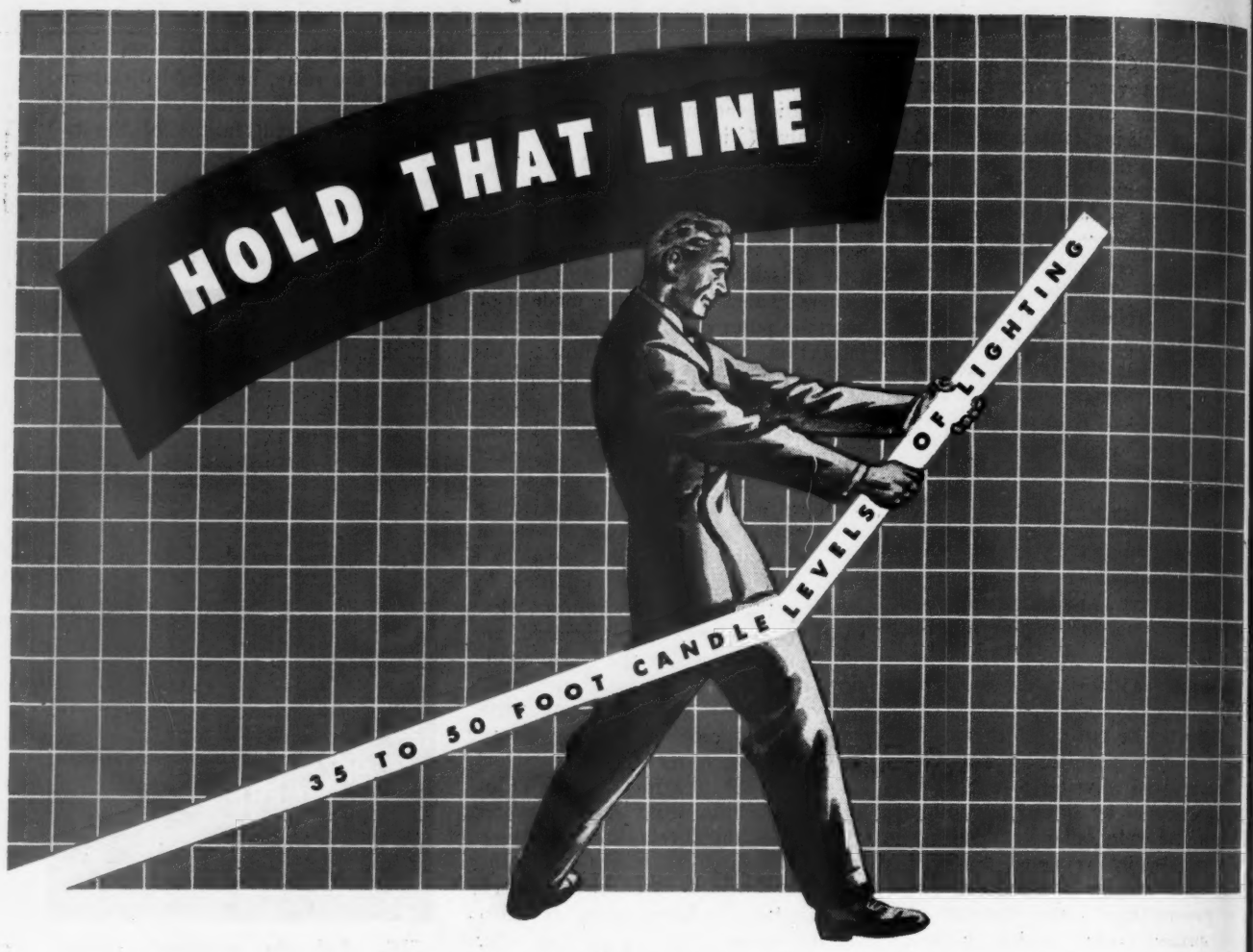


FIG. 3—Water to water cooling system for ignitron rectifier



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to operate. If the rectifier is under load it should shut down, unless the contacts are shunted out temporarily during the test.

Reference to Fig. 1 will show a "by-pass throttle valve" around the automatic thermostatically operated water valve. This by-pass valve should be adjusted to allow the constant flow of a small volume of water (one-half to one gallon per minute). The purpose of this trickle is to have some water flowing always past the sensitive bulbs of the over-temperature thermostat and the automatic water valve. Otherwise these devices would not get a signal when the tube temperatures increased, when the rectifier starts to carry load. Obviously, the water flow relay must be adjusted to shut down the rectifier when the water flow falls lower than that volume allowed to flow constantly through the bypass valve. The manufacturer's instructions should be followed in making the correct relay and by-pass valve settings. An occasional check on the quantity of water flow through the by-pass, measuring the discharge rate in a pail, is advisable to see that the calibration of the by-pass valve remains fixed.

Type (b) (Fig. 2) raw water cooling systems require checking both the raw water supply and the recirculating water to make sure that there is adequate cooling water. Inspection of the water level in the mixing tank will indicate whether the system is full. Water should be level with the tank discharge pipe. Since for these systems there is no by-pass throttle valve and no water flow relay, there will not always be discharge water flowing to the sewer. When there is, a visual examination instantly proves that the raw water supply is adequate. Under no-load condition, no discharge water should be flowing, and it is necessary to wait until sufficient load is present to check the discharge water, or otherwise temporarily reset the automatic water valve down to a low enough temperature to cause it to open.

Automatic Water Valve

The automatic water valves are usually mechanical valves (Fig. 3-A). The poppet of the valve is operated by a rod connected to a diaphragm or sylphon bellows. These bellows are in turn connected by a capillary tube to a sensitive bulb and the latter system partly filled with a liquid whose boiling point is near the temperature which it is desirable to maintain. Its vapor pressure thus corresponds to the temperature of the liquid in the sensitive bulb (the bulb being in the rectifier cooling water) and consequently the position of the diaphragm or bel-

INSPECTION CHART

PERIOD	WHAT TO INSPECT	WHAT TO LOOK FOR
Program for every 24 hrs., or every shift, or otherwise as determined by local conditions.	**RECTIFIER:**	
	Water flow	Make sure rectifier has adequate cooling water.
	Cooling system	If system is recirculating, check level of water in system. See if water is leaking anywhere.
	Tube operation	Note if all tubes are firing and carrying load.
	Operating temperature	See if any part of rectifier is too hot. If there are electric heaters on rectifier, check to see if they are operative.
	Records	Record any arc backs or tube replacements in daily log book.
	TRANSFORMER:	
	Operating temperature	Note thermometer reading.
	Liquid level	Note liquid level if transformer is oil or askarel* filled.
	Liquid leaks	See if any liquid leaks are noticeable.
	Fans	If fans are used, make sure they operate properly.
	Diaphragms or gas seals	Make sure any diaphragms or gas seals are tight.
	Transformer noise level	Listen to transformer. Any erratic bumping noted may indicate tube mis-fire.
* Non-inflammable liquid for transformer cooling.		
	SWITCHGEAR AND CONTROL:	
	Power circuit breakers	See that breakers are in the operating positions they are supposed to be in, i. e., opened or closed.
	Ignition checking relay	See if this relay indicates presence of ignitor mis-fire.
	Heating	See that no part of the switchgear is unreasonably hot.
	Meter readings	Observe voltmeters, ammeters, wattmeters, and any other station instruments to see if load conditions are normal. Record them in daily log book. Record notes on any work done or repairs made in daily log book.
Program for every month, or otherwise as determined by local conditions	**GENERAL:**	
	Clean the complete rectifier unit. Note: The rectifier should be disconnected from both a-c and d-c power systems for complete safety	Wipe off dust and dirt from all apparatus and blow or vacuum-clean the dust from switchgear, control relays, ignitor excitation equipment, tubes, tube seals, tube insulator supports, cooling system, surface cooler, auxiliary power transformers, etc. In effect, this means to clean carefully everything that is accessible without major disassembly.
	RECTIFIER:	
	Cooling system	
	a. Water circulating pump	Inspect for excessive vibration.
	b. Water flow relay	Test it to be sure its contacts will operate by turning the water supply off and on.
	c. Water pressure relay	Test it to be sure its contacts will operate by stopping and starting the water pump.
	d Thermostatic water valve	Test it to be sure it will operate to control water flow by cutting water supply too low for the load being carried at incoming supply valve. This will cause temperature to increase and thermostatic valve

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lows depends on the vapor pressure. Vapor pressure in the syphon is balanced by an adjustable bellows return spring. Thus the position of the valve poppet will depend on the sensitive bulb temperature. The operating temperature of the valve is adjustable by setting the bellows return spring pressure. For most sealed rectifiers this setting should be such that the valve opens at 45-50° C.

Operation of the valve may be tested while the rectifier is under load. Mark a point on the operating rod of the valve. Then restrict the supply water to the rectifier temporarily to a volume less than that needed to hold the temperature constant. The automatic valve should open wide when the temperature increases above its setting and the marked operating rod should move in the direction away from the bellows. Then suddenly open the supply water valve and the rush of raw water should cool the rectifier down quickly below the setting of the automatic valve, when the valve should close completely. Differential between completely open and completely closed should not exceed 5° C.

Sometimes these water valves become clogged with sediment or debris. This causes the valve to be sticky in action and may prevent complete closure. If the valve is sticky, it will be noticed that the differential between open and closed position will exceed 5° C and therefore the operating temperature of the rectifier will fluctuate abnormally over a wider range. When this occurs (and the maintainer will soon find, from experience, how often to expect it), the bottom cap should be removed and the strainer and inside of the valve carefully cleaned. It may even be advisable to replace the valve seat, if it is replaceable, or to reseat the poppet with pumice powder, if the seat is not replaceable. Care should be exercised in reassembly, in that all parts are mechanically free and properly aligned. The operating rod enters the valve body through a stuffing box. This box must not be tightened too much, as it will increase the friction loading on the bellows and make the valve sluggish.

Checking Water Flow in Recirculating Systems

Type 1 (b), water-to-air and water-to-water systems make use of recirculation. This means that there must be a tank, reservoir, or surface cooler in which a minimum level of coolant must be held. Usually these devices are equipped with glass water level gages near which the desirable level is marked. Regular daily inspection should always include checking these gages and, when necessary, filling the

PERIOD	WHAT TO INSPECT	WHAT TO LOOK FOR
Program for every month, or otherwise as determined by local conditions. (continued)		should open wide. Then suddenly open supply valve and the thermostatic valve should close suddenly. If it doesn't close completely, inspect for trash in valve seat. Check temperature range between complete open and complete closed position. (Should not exceed 5 degrees C.)
	e Leaks	Inspect complete cooling system carefully for any water leaks.
	TUBES:	
	a Load balance	Measure and record the anode current in each tube with clip-on ammeter.
	b Color of arc	Note color of arc to see if tube has become leaky. (See Part III of this article for details).
	c Mechanical	Note any water leaks or evidence of cracks in glass seals, coating on seals or deterioration of leads and terminals.
	d Arc back	If the rectifier has arced back during previous month, test the vacuum of each tube, using spark coil, click, or bubble test.
	e Tube temperature	Check operating temperature of each tube to see if temperatures are within proper limits.
	f Excitation tubes	If thyratron tubes are used in excitation circuit, check them for color and emission.
	Excitation equipment	
	a Connections	Inspect wiring for loose connections.
	b Heating	Look for any evidence of overheating.
	c Operation	Test to see if each ignitor gets proper impulse and also test to see that the firing timing is correct.
	TRANSFORMER:	
	a Relays	See that any transformer protective relays function as they are supposed to.
	b Gas absorbers	If gas absorbers are used, inspect for damp or caked compound and replace if necessary.
	c Core and coils	If transformer is dry-type, inspect leads, horizontal surfaces, and ventilating ducts, and clean if necessary with clean dry air or nitrogen.
		Eliminate any causes of corrosion.
	d Temperature alarm	See that alarm functions properly.
	e On water cooled transformers	Check temperature of ingoing and outgoing water and also water pressure and flow.
	f On forced oil cooled transformers	Inspect pump glands, oil level, cooler screens, and oil screen for defects, leaks, or dirt accumulations.
	g Load ratio control apparatus	Check adjustments and operation of contact making voltmeter, relays, fuses, etc.
Program for every 12 months period or otherwise as determined by local conditions	RECTIFIER:	
	Electric heaters	Inspect for burnouts and replace any that have failed. Remove any corrosion.
	Cooling system	Clean out any accumulations if the system uses direct raw water. The period will depend on local water conditions. Open water connections at the tubes and inspect for evidences of corrosion or deterioration in both piping and waterjackets of the tubes.

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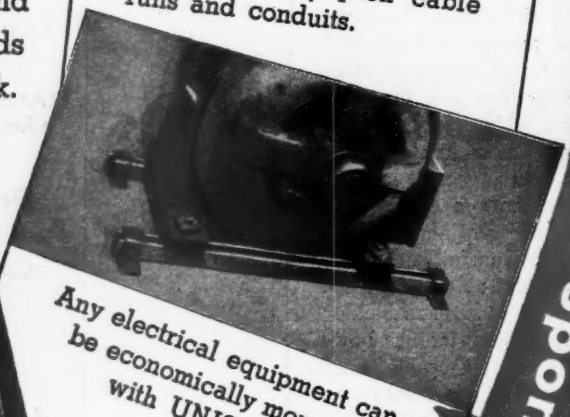

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system with more coolant. Usually, if the coolant contains anti-freeze, it evaporates more rapidly and the system requires more frequent refilling. When the sight glass becomes dirty or stained it should be removed and the inside of the glass cleaned.

A centrifugal pump is used to circulate the coolant. It is installed at a level in the system below the minimum water level so that it always remains primed. The pump is ordinarily immersed in the coolant with a vertical motor drive to avoid the need for a packing gland and attendant leakage. If the pump has packing glands, they should be kept reasonably tight and the packing changed regularly to avoid excess leakage. Vertical pumps that have the pump below water and the motor above, require only annual lubrication. It is most important to avoid excess grease. Occasionally the pump should be inspected for loose nuts and connections. If vibration occurs, the pump should be disassembled and any worn or unbalanced parts replaced. Before restarting be sure the shaft is properly aligned by turning it over by hand. There should be no binding.

Recirculating systems employ electrical water pressure relays to protect the rectifier in case of loss of water or motor driven pump failure. These relays are set to operate just below the normal water pressure at the discharge of the circulating pump. The relays may be tested by stopping the motor driven pump, which should cause the rectifier to shut down unless the relay contacts are temporarily shunted. It is advisable to test the relay calibration by means of a pressure gage at least annually.

Analysis of Cooling Water

Direct raw water should only be used for cooling when its purity is suitable and it can be obtained at a reasonable cost. Most water fit for drinking is suitable, but to qualify for direct use in the stainless steel sealed ignitron tubes it should have the following purity:

a. Neutral or slightly alkaline reaction, i.e., a PH between 7.0 and 9.0.
b. A chloride content of not more than 20 parts per million; a nitrate content of not more than 10 parts per million; and a sulphate content of not more than 100 parts per million.
c. A total solids content of not more than 250 parts per million; and
d. A total hardness, as calcium carbonate, of not more than 250 parts per million.

Direct raw water systems are the most popular types because they are simpler and there is usually available

PERIOD	WHAT TO INSPECT	WHAT TO LOOK FOR
Program for every 12 months' period or otherwise as determined by local conditions. (continued)	Dry plate rectifiers	Test each stack to see if any discs have failed.
	TRANSFORMER: Inside of tank	Look for sludging or water condensation under cover or on top of core and coils. Remove any present after lowering liquid, by washing with oil or as'karel from nozzle at high pressure (80 p.s.i.)—then remove and filter. Note: The period for such inspections may be increased, depending on load and ambient temperatures.
	Fan lubrication	Lubricate with grease or oil recommended by manufacturers. Note: Avoid excess grease.
	Tap changer	Operate to make sure mechanical parts are in good condition and surfaces smooth.
	Connections	Check all accessible connections including internal terminal boards for tightness.
	Load ratio control	Filter and clean oil in ratio adjuster and contactor compartments. Clean all inside surfaces. See that contactors make good contact. Amount of load and number of operations determine life. Check contact pressure after installing any new contacts needed. Inspect arcing ratio adjusters for wear, alignment, and tip pressure. Inspect stuffing boxes on rotating shafts and keep them oiltight. Glands may be taken up but avoid excessive tightening, which causes scoring. On mercury-type stuffing boxes see that mercury head is at proper level. Check limit switches and reversing relay for dirt and corrosion and remove any present. Check proper mechanical operation by operating throughout complete range at least once a year. Check brake shoes for wear, commutator of motor for commutation, and rotating parts for free operation and proper alignment. Inspect ventilators and free them of any obstruction.
	SWITCHGEAR: Air circuit breakers a Connections	Inspect all connections for looseness or heating, and tighten them.
	b Mechanisms	Tighten all loose nuts, bolts, screws, or cotter pins. See that all moving mechanisms operate freely, oiling or greasing where necessary. Replace worn parts. Operate mechanisms several times manually as complete check. Make sure everything is clean and properly aligned.
	c Contacts	Check condition of arcing contacts, dressing or replacing any that are burned or pitted. Check for correct pressure.
	d Tripping devices	Test for proper calibration. See that mechanical parts move freely, are clean, and strike a positive blow that will open breaker.
	e Cleanliness	Use kerosene or naphtha. Wipe

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water which passes the above requirements. However, nearly all mining rectifiers use water-to-air systems because the mine waters are so acid and corrosive.

When mixing tanks are employed, obviously the only purpose is to maintain some desirable fixed velocity of water and a fixed temperature on all of the tubes. On the other hand, water-to-water heat exchangers are employed when an inexpensive and adequate supply of raw cooling water is available, but its purity is not satisfactory for direct use on the tubes. Such water-to-water heat exchangers are always designed so that the raw water side of the heat exchanger may be readily cleaned of any accumulation or sedimentation. The maintainer should find from experience how often to clean the raw water side of these water-to-water heat exchangers for each particular location.

A recognized corrosion inhibitor is usually used in the coolant of water-to-air or water-to-water systems. Both of the following corrosion inhibiting chemicals have proven satisfactory.

a. Sodium Chromate (Na_2CrO_4)
If the user employs distilled water as a coolant, add 1/10 of 1 percent by weight of anhydrous sodium chromate. If, instead of using distilled water, raw water of a purity previously specified is used, add ½ of 1 percent anhydrous sodium chromate.

b. Sodium Dichromate ($Na_2Cr_2O_7$)
If distilled water is used, add ½ of 1 percent by weight of sodium dichromate and ½ of 1 percent of borax. If raw water of the quality previously specified is used, add 1 percent of sodium dichromate and 1 percent of borax.

Cleaning the Water Cooling System

One of the most important things about the care of sealed ignitron rectifier equipment is to keep the water cooling system thoroughly cleaned. Any accumulation of debris or any sedimentation in the system has the effect of reducing the efficiency of heat removal from the tube and thereby tends to lower the operating reliability of the equipment. It may even result in permanent damage if allowed to become too bad. Another consideration directly related to the question of keeping a clean water cooling system is electrolytic corrosion. The presence of various salts in the recirculating coolant, or direct raw water, may tend to cause corrosion due to electrolysis, especially since the water cooled tubes operate at a potential which is positive with respect to a grounded heat exchanger or raw water supply.

PERIOD	WHAT TO INSPECT	WHAT TO LOOK FOR
Program for every 12 months' period or otherwise as determined by local conditions. (continued)		dry with clean cloth. Do not use liquids that may dissolve plastics.
	f Heating	When breakers are carrying load, check to see if there is any abnormal heating.
	Power circuit breakers a Oil	If it is an oil breaker, the oil should be kept to 22,000 volts dielectric strength. It may be necessary to inspect more often than every 12 months, depending on load and frequency of operation.
	b Mechanical	See that breaker mechanism operates freely by manual method. Clean and lubricate all toggles, buffers, dashpots, etc. Test and adjust breaker stroke to agree with manufacturers' instructions.
	c Electrical	Operating voltage should be correct. Check closing relay and clean. Replace burned out indicating lamps. Test operating time. Test tripping arrangement, preferably by actually operating relays electrically. Inspect, clean, and test under-voltage devices, auxiliary switches, and interlocks. See that all bushings and insulating parts, both internal and external, are clean. Hi-pot bushings. Inspect them for cracks. Remove arc chutes and clean loose arc products from chute. If arc chute is moist, heaters should be installed to keep arc chutes dry.
	d Oilless breakers	For oilless breakers access to the contacts is easy. For oil breakers the tank must be removed or, if the breakers are too large, the oil must be withdrawn and access obtained through manhole in the tank.
	e Contacts	Check contact alignment, see that surfaces make contact with firm, even pressure and are adjusted according to manufacturers' instructions. Dress roughened contacts with a file or sandpaper and replace contacts which are burned beyond repair, When dressing line-pressure contacts, be sure to maintain the intended line-contacts.
	f Relays	Each relay element should be tested for over-current, time setting, current, potential, pick up, drop out, etc., at intermediate points. Where power circuit breakers are operated from relays, such relays should be operated electrically to trip the power circuit breakers.
	g Metal enclosures	Metal enclosed switchgears should be de-energized and then opened, and all internal parts, especially insulators, wiped clean. These precautions are especially necessary in dusty, salty, or acid atmospheres.
	h Voltage regulators	Remove cover and clean out dirt or dust. Wash or replace dust filters in cover. Test calibration of regulator and re-adjust if necessary. Inspect contacts for burning or evidence of heating and dress or replace if necessary. See that all moving parts are free in action.
	i Indicating lamps	Replace weak or burned out lamps

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5. Moisture-proofed rip-cord
6. Paper sheath, to keep compounds from penetrating interior
7. Outer Braid, saturated with ingredients which resist moisture, retard flame; and coated with the new Mica dry finish.

No telltale marks are left on walls or woodwork when a job is wired with "WALKERflex". The new flexible *dry* finish is one reason for that. It keeps workers' hands from becoming smudged even after all-day handling.

Other important advantages too are provided by this new finish. *It does not get sticky in hot weather.* It allows cable to uncoil easily and bend without cracking, thus making it easier and quicker to install.

Supplied in six sizes in either two or three conductors. Ask your Walker Distributor for prices and delivery information, or write direct to WALKER BROS., Conshohocken, Pa.

***WALKERflex* is inspected and labeled by Underwriters' Laboratories and is approved for use under the provisions of the National Electrical Code.**

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Makers of Rubber-covered Synthetic and Lead-covered Wires and Cables * "Walkerflex" Non-metallic Sheathed Cables * Service Entrance Cables * Automotive Wires and Cables * Shipboard Cables—Leaded, Non-Leaded; Synthetic or Varnished Cambric Insulation * Electrical Metallic Tubing * "Dualcote" Rigid Steel Conduit * "Preset-Insert" Underfloor Distribution Systems.

PERIOD	WHAT TO INSPECT	WHAT TO LOOK FOR
Program for every 12 months' period or otherwise as determined by local conditions. (continued)		and test for proper electrical indication.
	j Control switches, bus bars, and connection bars	Inspect these carefully for damaged parts, which should be repaired or replaced. Any evidence of overheating should be corrected by tightening, replacing, or removing excess load if present.
	k Small transformers	Small transformers should be inspected to make sure that they are clean and that all connections and fuses are intact.
	l Rheostat mechanisms	Clean, lubricate, and adjust them.
	m Interlocks	Test all interlocks to make sure that they function as intended.
	n Meters and instruments	All meters and instruments should be examined and tested by a competent meter technician.
	o Contactors	Clean and inspect for evidence of heating. Replace burned contacts or charred coils. Test for freedom of moving parts. Adjust and test for proper contact pressure. Tighten all connections, inspect and clean, or replace, dirty or broken arc chutes and barriers. Replace any damaged flexible shunts.

Most rectifiers operate with part of the cooling system at ground potential and part positive with respect to ground. This follows from the fact that the metal envelopes of the sealed ignitrons are really the positive terminal of the rectifier. Therefore the water in their cooling jackets and the water connections to the tubes are positive in voltage. Insulating hose or plastic tubing is used to carry the water between grounded parts of the water system and the tubes. Where rectifier circuits of the delta six-phase, double-way type (No. 5 of Table I) are used, the tubes do not all have the same potential. Therefore, for such rectifiers insulating hose or tubing is used in the water system between tubes.

Obviously a small amount of current will flow from the positive parts of the water systems to the negative or grounded parts. The magnitude of this current depends on the conductivity of the water. Evidence of excessive electrolytic current through the water connections takes the form of corrosion at the hose nipples or metal connections at the positive ends of the insulating hose or tubing. Frequently electrolytic rods of copper or steel are inserted at those points in the water system to act as targets for the electrolytic current. The current concentrates on the target which can be replaced more inexpensively, when it is eaten away, than the hose nipples. It is important for the maintainer to keep electrolytic currents as low as possible by using pure cooling mediums to reduce the conductivity. He should also know from careful watching and experience how fast the electrolytic targets, or hose connections, corrode away and plan to replace them on schedule when necessary.

If evidence of unusually bad corrosion is found, it is advisable to emphasize the condition to the manufacturer's representative, and get the manufacturer's recommendation for overcoming the trouble.

Testing the Strength of Sodium Chromate Solution

Usually systems making use of sodium chromate or sodium dichromate as an inhibitor in the coolant do not require cleaning if the corrosion inhibitor is kept at proper strength. The strength of the corrosion inhibitor in a coolant may be tested as follows:

1. Equipment used.
   a. 6 oz. wide mouth glass bottle.
   b. A cork or rubber stopper provided with two polished iron wire electrodes protruding through the stopper and extending to within ½-inch of the bottom of the bottle. The electrode should be iron wire ⅛ inch in diameter and spaced 1 inch apart.
   c. A d-c source of power five volts potential from dry cells or storage batteries.
2. Tests.
   Fill the bottle with a sample of the coolant in question. Maintain some convenient temperature, always using the same temperature for each of the tests, to get comparable results. For instance, use the average ambient temperature for the locality. Insert the stopper with the electrode and apply five volts across it. If the solution is too weak, a greyish cloud formation of precipitate will become visible near the iron electrodes within five to 30 minutes. After several minutes the grey precipitate changes to brown or iron oxide.

When evidence of weak solution is found, the solution should be strengthened and a test repeated. When the solution is of proper strength, it will remain clear throughout the test. For each test the bottle should be cleaned thoroughly and the electrodes should be cleaned, or replaced if necessary. In replacing the electrodes, proper spacing should be maintained.

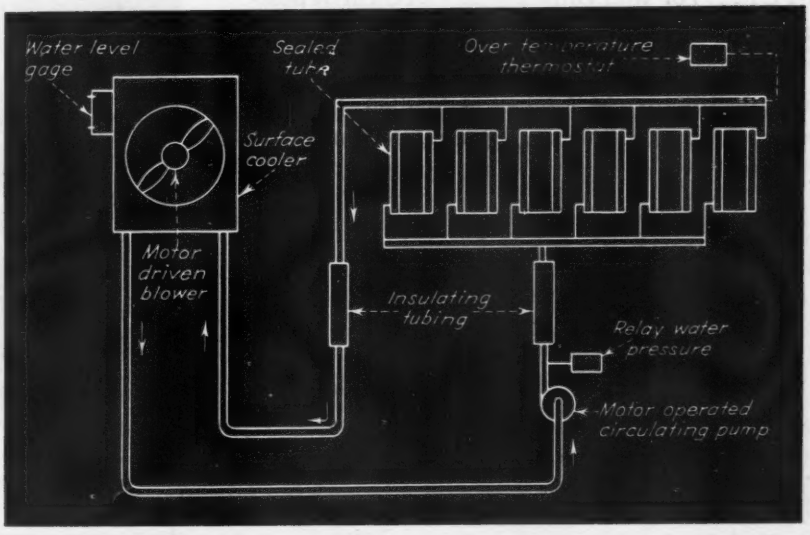

FIG. 4—Water to air-cooling system for ignitron rectifier

POWER CIRCUIT TRANSFORMERS WITH OVERLOAD and SHORT CIRCUIT PROTECTION

Safety and Utility

IN ADDITION to providing lower voltage from the higher voltage plant distribution circuits, Jefferson Power Circuit Transformers with built-in Circuit Breakers, give overload and short-circuit protection.

In connection with remote control station, for example as shown in the illustration, these transformers make possible a combination that meets the electrical safety standards of the National Machine Tool Builders Ass'n.

Mounting transformers directly on machinery has come into wide use also where in addition to supplying lower voltage for small electric appliances, localized lighting units are employed as a means of reducing eye fatigue and improving output.

Jefferson Power Circuit Transformers are used in America's leading War goods and essential industrial plants. Chances are you can gain by their use also. Let us have your problem or write today for Bulletin 421-PCT . . . For your convenience Electrical Wholesalers everywhere carry Jefferson Electric Products . . . JEFFERSON ELECTRIC COMPANY, Bellwood (Suburb of Chicago), Illinois. *In Canada:* Canadian Jefferson Electric Co., Ltd., 384 Pape Avenue, Toronto, Ont.

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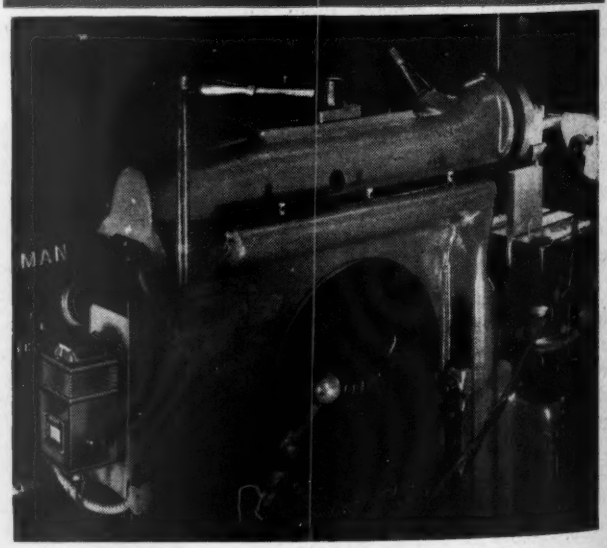

Illustration shows Jefferson Electric Transformer mounted directly on machine tool driven by 440-volt motor. Transformer provides 115-volt current for control circuits and lamp.

Methods of Cleaning Dirty Cooling Systems

When inspection shows that passages in the water cooling system, which are not accessible to mechanical cleaning, are becoming clogged, and its efficiency reduced, a complete cleaning of the system is indicated. The following method is suggested.

Circulate a hot solution of one of the following alkalies in the water system (2 percent in strength, by weight) for a period of 24 to 48 hours:

Sodium Metasilicate ($NA_2OS_1O_2$)
Sodium Carbonate (Na_2OCO_2)
Trisodium Phosphate (Na_3PO_4)
Sodium Tetraborate (borax) ($Na_2O(B_2O_3)2$)

The solution should be held at approximately 50° C during the cleaning period.

Compressed air can be introduced into the cleaning solution while it is circulating for the purpose of mechanical agitation.

When the cleaning solution is drained from the water jackets of the tubes and cooling system, it should be allowed to run out rapidly so that the loosened material will run out with the drainage and not settle in the jacket. After the above procedure, flush out the system thoroughly with clear water to remove all sediment and traces of the cleaning agent.

If scale or products of corrosion are encountered which, because of their chemical nature, will not respond to any of the above alkalies, an acid agent must be used. First, make a solution consisting of undiluted hydrochloric acid and an organic inhibitor, such as Rodine No. 101, for reducing the tendency of the acid to dissolve the base metal without reducing its ability to attack scale and rust. A 3 percent solution by volume of Rodine No. 101, will give this protection.

After having made the solution of hydrochloric acid, add from one part of solution to three parts of water to one part of solution to one part of water in the system, depending upon the thickness of the scale. Allow the mixture to remain in the cooling system for eight hours or less, and then remove and thoroughly flush with clean water.

How to Use Anti-Freezes

It is often necessary to use anti-freeze compound in the recirculating coolant of sealed ignitron rectifiers. Usually when it is necessary to prevent freezing of the coolant, the sealed ignitron rectifier is supplied with a water-to-air heat exchanger.

The use of ethylene glycol compounds is not recommended unless their corrosion inhibitors are completely effective.

Experience has proved that methyl alcohol base anti-freezes are successful in sealed ignitron rectifiers. Methyl alcohol containing borax and a little chromate, and which can be obtained in normal times commercially, very easily, is very satisfactory for use in systems, where no potential difference exists between the heat exchanger and the tubes. However, since the borax in this compound makes the solution relatively highly conductive it should not be used when the tubes are at different potentials or when the tubes are at a different potential than the heat exchanger.

When these differences in potential exist between various parts of the cooling system an anti-freeze made of pure methyl alcohol and distilled water may be used. Since there is no rust inhibitor the solution must be watched closely for corrosion and it should be changed whenever it begins to turn red. An anti-freeze which will not cause corrosion and which also does not have high conductivity, but which will also have long life presents somewhat of a problem.

There are a few precautions which should be observed in connection with the operation of the cooling system of a rectifier which uses anti-freeze. It should be remembered that alcohol base freezing preventives are inflammable when handled in their concentrated or pure form. However, after they are mixed in the solution they are not inflammable. Loss of the alcohol by evaporation should be minimized to reduce the operating expense. This evaporation can be minimized by operating the temperature of the rectifier as low as possible, still keeping within the manufacturer's recommended operating range, and by keeping the system closed as much as possible. This means that the only portion open to atmosphere should be the smallest vent which will permit successful breathing.

TABLE I—POPULAR TUBE AND CIRCUIT COMBINATIONS.

	NUMBER OF TUBES
1 - DELTA, 3 PHASE, ZIG ZAG	3
2 - SCOTT, 4 PHASE, CROSS	4
3 - SCOTT, 4 PHASE, DOUBLE DIAMETRIC	4
4 - DELTA, 6 PHASE, DOUBLE WYE	6
5 - DELTA, 6 PHASE, WYE DOUBLE WAY	6
6 - DELTA, 6 PHASE, QUADRUPLE WYE	12
7 - DELTA, 12 PHASE, QUADRUPLE ZIG ZAG	12

Much is written these days about the need for underground cables to provide freedom from service failure in the city. Farmers not only have need for underground entrance cable but they also need underground distribution cable from the meter to the various outbuildings.

They are going to need a lot of other things too, besides underground cable. They are going to need a lot of wiring in barns, in hen houses, and progressive farmers will need soil heating cable too. All this is in addition to the household appliances city folks want. In other words, the market for electrical contractors' services in the country is even more attractive than it is in the city.

Now about this underground cable business. Unless you sell your prospect a dependable cable, your reputation is at stake. Your logical choice for this all important underground cable job is Simplex-ANHYDREX Cable. It has a very low water absorption rate. It is not affected by most soil conditions and it is a stable, wholly reliable cable. If you want further information we'll be glad to supply it to you.

Simplex Wire & Cable Co., 79 Sidney Street, Cambridge 39, Mass.

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WIRES and CABLES

INDUSTRIAL ELECTRIFICATION

ENGINEERING • INSTALLATION • MAINTENANCE

The Control of Static Charges

Static electricity produces numerous industrial hazards, particularly in the petroleum industry. The control methods outlined below—based on proper installation and maintenance—will interest all practical electrical men

By John G. Buss, Jr.
Assistant Electrical Engineer
The Pure Oil Company
Chicago, Illinois

THE effects of stray currents and powerful electrostatic fields inadvertently introduced in electrical and mechanical installations have been recognized for some time. In spite of this, however, there is still a lack of accurate, non-technical information on the subject that the practical engineer, contractor or maintenance man can apply to a specific problem. The result of this has been improperly engineered jobs and inadequate maintenance with its resultant hazard to life and property. In the oil industry, particularly, great care must be taken to detect these stray currents and dangerous high potential fields and eliminate them. The danger of fire from arcs or sparks is always present as well as the hazard of accelerated deterioration of equipment due to stray currents. The purpose of this article is to cover as concisely and completely as possible our experience and practice in the detection and elimination of these currents and potentials.

For purposes of simplification the subject will be separated, insofar as possible, into two general groups—potentials built up by electrostatic fields and stray currents.

Potentials induced in materials by strong electrostatic fields are familiar to most people as static electricity. Because of the high potentials involved the presence of static electricity can usually, but not always, be detected. When the potential of a material reaches the critical value, a disruptive spark will leap to ground. If this discharge takes place in a hazardous atmosphere, an explosion will result.

On the other hand, stray currents are often of such minute values that their detection and elimination is extremely difficult. They usually take the form of leakage currents from cables and electrical machines, currents generated by chemical or electrolytic action and current flow caused by minute differences of potential existing in an interconnected system.

Except under certain conditions stray currents will not produce arcs or sparks and for this reason they do not present the direct hazard of explosion that static discharges do. Their principal evil lies in the corrosion of pipes, conduits and metal structures with consequent failure; also the accelerated deterioration of cable insulation and unnecessary power loss.

High voltage, high amperage leakage currents appearing as flashovers on insulators and switches are a source of danger, but proper application and competent maintenance will keep trouble at a minimum. The usual location of open type switches and insulators out of the hazardous areas removes the danger of igniting explosive atmospheres. Since standard, good engineering practice will suggest remedies for these conditions, no further discussion of high voltage power arcs or flashovers will appear in this article.

Electrostatic fields and the insidious role they play in the petroleum and in most processing and manufacturing industries will be taken up first.

Since static charges can appear in such a variety of places and under such widely varying conditions, no specific rules for their elimination can be set forth. Each case must be studied separately.

To facilitate the application of sound principles to its control, a brief summary of the theory of static electricity and its appearance in specific cases will be given.

According to the atomic theory, all matter is composed of atoms. Each atom consists of a large nucleus surrounded by smaller particles called electrons. Each electron bears a negative charge of electricity, and the nucleus bears a positive charge equal to the negative charges on the surrounding electrons. Thus, each atom in the normal state is neutral.

Under certain conditions the balance between the charges on a substance may be upset so that the substance acquires more of one kind of charge than the other. A material under these conditions is said to be electrified.

Unwanted electrification of a substance with its attendant sharp rise in relative potential may take place in many ways, but probably the most common cause is friction between dissimilar materials. For example: If a glass rod is rubbed with a piece of silk, both the glass and the silk are found to be electrified. This electrification is caused by

some of the electrons leaving the glass rod and attaching themselves to the silk, thus leaving a surplus negative charge on the silk and a surplus positive charge on the glass rod. Moving the glass rod close to a grounded object will enable the charges to reunite, and a spark will leap from the rod to the grounded object.

In the operation of oil processing and pumping equipment and in the storage of petroleum products, it is inevitable that hazardous static charges will be built up in many pieces of equipment. Since it is impossible to entirely keep these charges from developing, some means must be introduced to drain them off to ground before a dangerous potential appears.

Petroleum Pipe Lines and Storage Tanks

The flow of petroleum products through a pipe is such that particles in the stream are constantly touching the inside of the pipe and then being violently forced away. This causes a rearrangement of charges between the stream and the pipe wall, and the stream will gradually build up a potential with respect to the pipe. As the potential in the stream rises, current will be returned to the pipe wall by conduction and by repulsion and attraction of the existing charges. This return of current will continue until the rate of discharge equals the rate of charge. At this point the charge in the stream becomes a fixed quantity and is maintained at a constant value.

When the liquid arrives at a tank or other vessel this charge is delivered with the stream. If the tank is properly grounded and bonded, the internal potential of the stream will force most of the incoming current to the oppositely charged tank walls, and it will be safely conducted to the ground. Some of the current, however, will not reach the tank walls directly but will leak slowly across the oil surface to the tank. When the rate of leakage is slow compared to the rate of charge being introduced at the oil surface, a potential will be built up on the oil surface which can become high enough to spark over to the tank wall causing an explosion.

It is obvious from the above that grounding the tank will eliminate most but not all of the hazard. The only way to completely protect the tank is to install a good ground system and either arrange the pipe inlet so the stream is delivered at the *bottom* of the tank or eliminate the oil surface entirely. This can be done by using a floating top tank or by relpacing the air at the top of the tank with an inert gas such as flue gas.

The voltages appearing in tanks and piping, although they may be very high (20,000 volts or more), are very difficult to measure because of their low amperage. Some methods of measuring static charges will be taken up later but in general they involve complicated equipment and skilled technique. *The safest method is to assume that static charges are always present when liquids are pumped through pipes or discharged into vessels.*

The most effective procedure in safeguarding tanks and piping is an efficient ground system. It must be borne in mind that suitable grounding does not mean a ground rod driven in the ground with a piece of wire connecting it to the tank. *A ground system should be as carefully engineered, installed and*

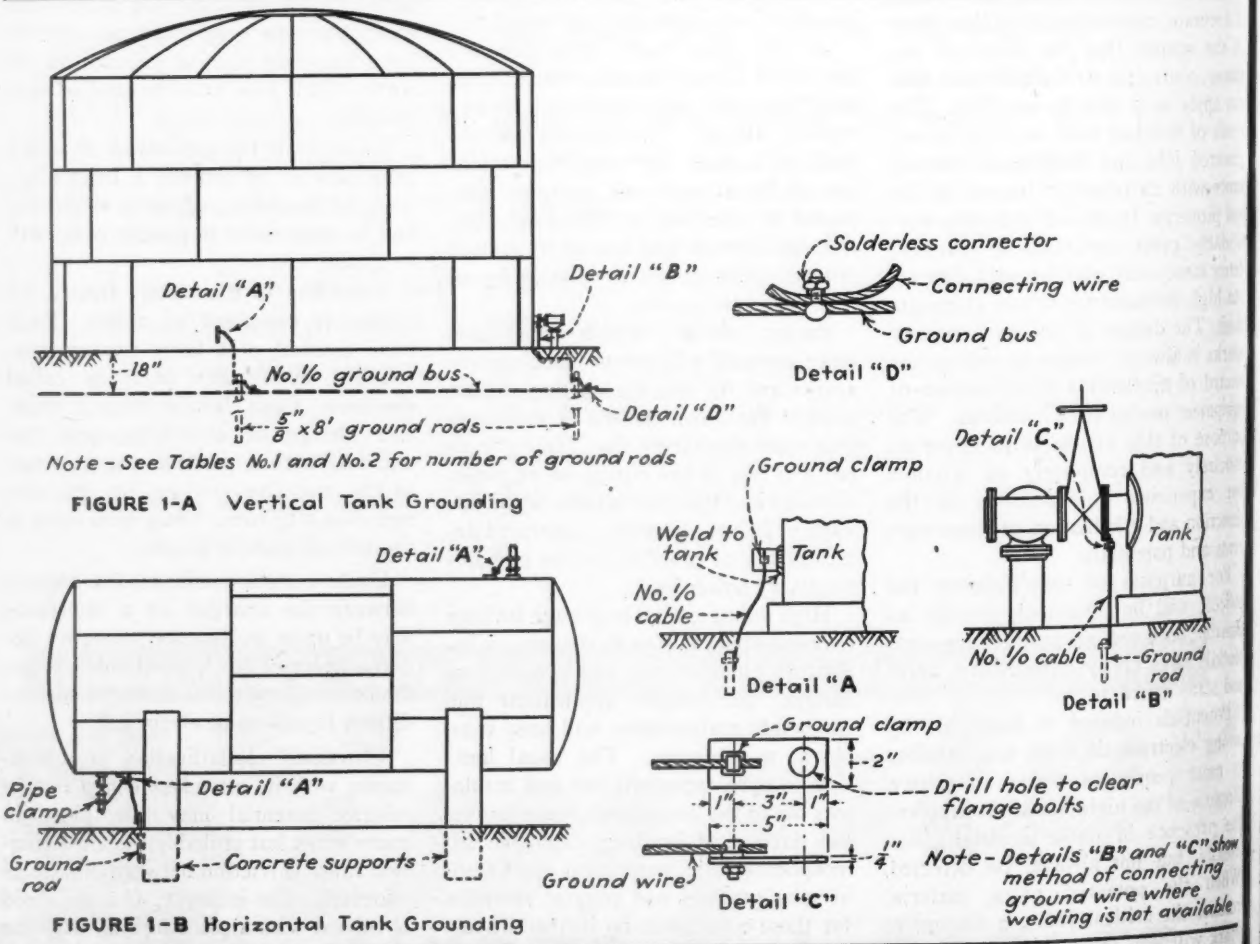


FIGURE 1-A Vertical Tank Grounding

FIGURE 1-B Horizontal Tank Grounding

FIG. 1—Grounding details for typical storage tank installation. If tanks rest on filled ground, soil resistance will not be uniform and ground cable should be installed completely around the tank.

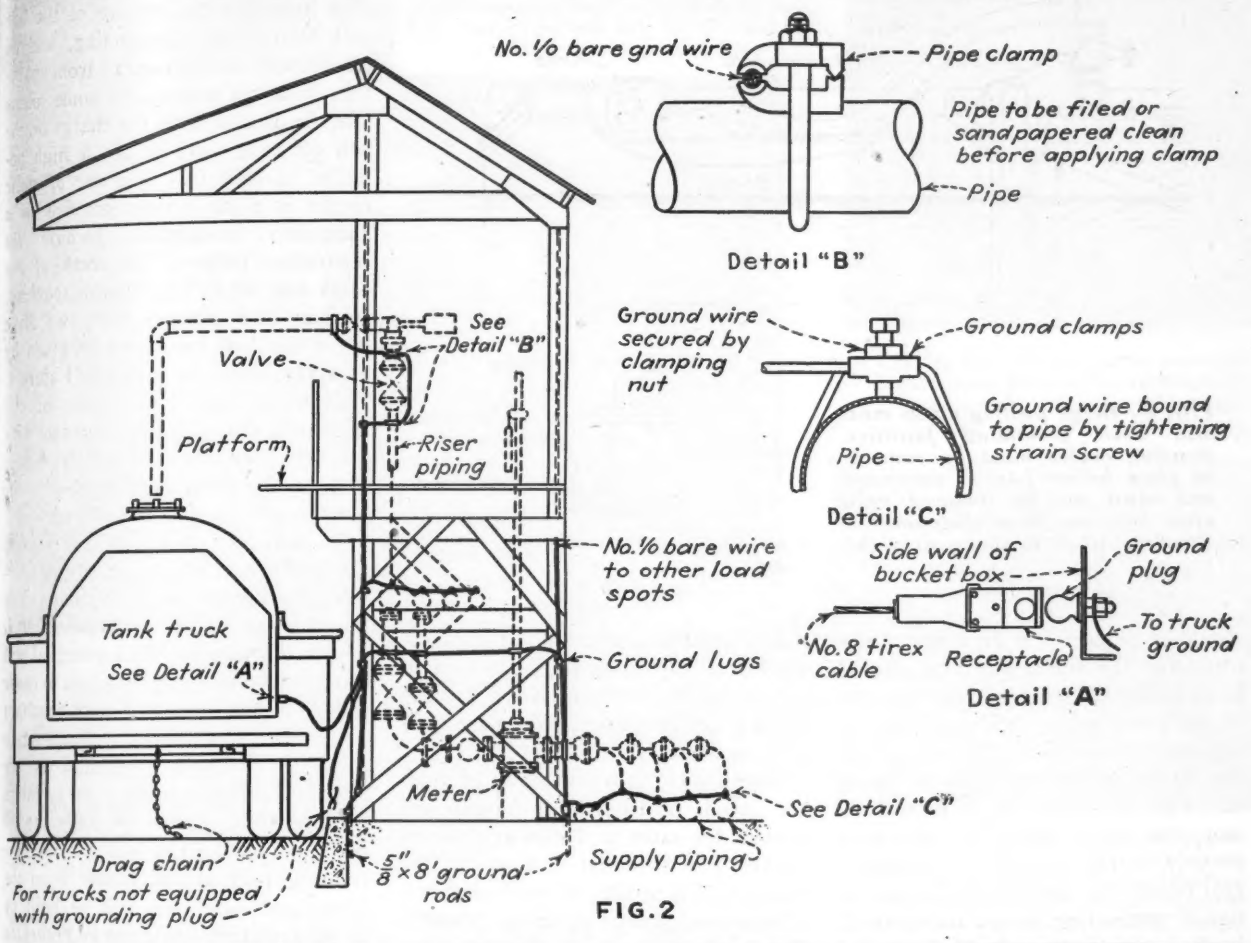


FIG. 2

FIG. 2—Loading racks must be carefully grounded and bonded. Details show one loading spot. All loading spots must be similarly grounded and bonded together by a common cable.

maintained as any other part of an electrical installation.

The design of ground systems will be gone into in detail in a second article, dealing with stray currents. Here, only a brief summary of tank and pipe grounding will be given.

In addition to securing a good ground connection at tanks, *care must be taken to be sure that all parts of the tank are grounded at a point of equal ground potential.* If this is not done, there may be a difference of potential between adjacent pipes although all pipes are grounded. This will be particularly true in a storage tank area where there are a large number of tanks interconnected by common piping. Differences of potential will cause sparking to adjacent pipes or metal structures.

Figure 1-A shows a standard arrangement of tank and connecting pipe grounding which we have found to give the closest balance of potential in all members.

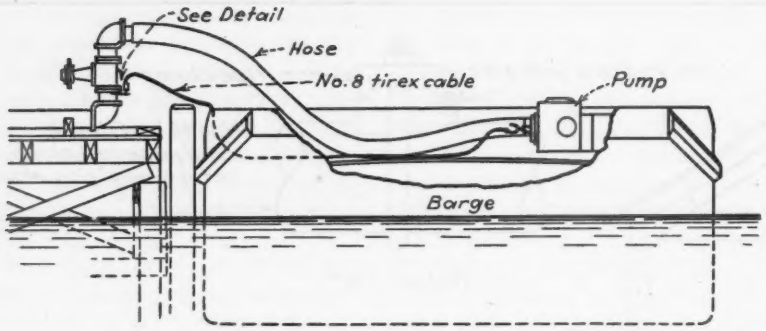
A ground bus should be laid completely around the tank and all ground rods should be connected to it. In the case of a group of tanks the ground bus should be placed around the group, and all tank grounds should be connected to it. In soil of uniform resistance the ground bus may be eliminated although this is not recommended. Connections to the ground system should be made with solderless connectors so they can be removed for ground testing. *Underground piping to tanks, if it is carefully bonded, makes an excellent ground in itself.*

Horizontal tanks are generally of smaller size than vertical tanks and are usually mounted on concrete supports. Since variations in ground potential will not have much affect on this type of mounting, the ground bus may be eliminated, and one ground rod used. The inlet and outlet pipes, however, must be grounded to the tank (See Figure 1-B).

Tank Trucks and Loading Racks

The mechanics involved in loading and transporting inflammable liquids in tank trucks introduces hazards from electrostatic fields to a greater extent than any other single operation.

When a tank truck moves over the road, the friction of the rubber tires on the pavement will generate a small potential in the tire at the point of contact. As the tire moves, the positive and negative charges are separated and gradually a high potential is built up on the part of the tire not in contact with the road. This high potential forces a current into the frame of the truck and a charge gradually builds up in the truck body. As the truck voltage rises, current will flow from the tire back into the pavement but at a low rate because of the small area of the tire that is in contact at any instant. When the incoming and outgoing currents balance, equilibrium will be established and the charge on the tank body will remain constant. This potential may be in the neighborhood of 20,000 volts. It must be remembered that the other half of this charge is in the ground, and contact between the truck body and any grounded object will cause sparking. The charge on the truck body can be lowered greatly by the use of drag chains. These chains



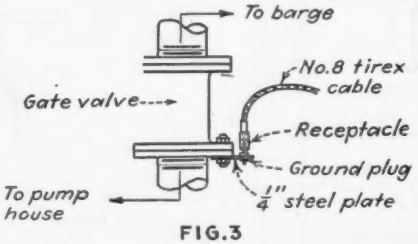


FIG.3

FIG. 3—Barge loading docks must also have grounding facilities. Bonding cables must be securely in place before hose is connected and must not be removed until after hose has been disconnected. Bonding detail is shown at right.

should be connected to the frame of the truck and the frame and tank should be carefully bonded together. Because of the unavoidably high resistance of the chain contact with the ground, all the charge on the truck will not drain off. For this reason *it is imperative that the truck body be grounded directly at the loading or unloading spot before the tank hatch is open.* A typical grounding layout for a truck loading rack is shown in Figure 2.

This arrangement will establish equal potentials on the truck body and on the loading rack piping and will eliminate any danger from the potential built up on the tank truck. However, there are other precautions which must be taken to assure 100 percent protection. If the loading spout is connected to the riser piping by means of a fabric hose, a definite hazard will be introduced. The oil flowing from the spout into the tank will build up a charge on the oil surface inside the tank. The opposite charge will be left on the insulating hose material. This condition will exist even though the truck and loading rack piping is grounded. If the surface charge leaks to the tank wall faster than the opposite charge on the hose leaks to the grounded piping, a spark will occur between the metal nozzle and the filling hatch. If these conditions are reversed, a spark may take place inside of the tank. If both leakages are slow, the spark will occur between the nozzle and the oil surface. The use of a continuous metal fill pipe reaching almost to the bottom of the tank and a grounding system as indicated above will completely eliminate any danger from this source.

If a metal fill pipe cannot be installed, the metal nozzle should be bonded to the piping by means of No. 8 flexible Tirex cable. This will reduce the hazard considerably.

The loading and unloading of volatile liquids transported in barges will present the same problems as outlined above. The potential built up on the barge itself is usually so small—because of excellent grounding to the water—that it can be ignored. However, because the resistance of the barge piping to ground and the resistance of the shore piping to ground are rarely the same, a bonding cable must be connected between the two. There may be a difference of potential between the barge piping and the shore piping which will cause sparking when connections are made and arcing when they are broken. Figure 3 shows a typical layout.

Wherever bonding cables are used, they must be connected before hatches are opened or hoses attached, and they must not be removed until hoses have been disconnected.

Miscellaneous Cases

Belt driven machinery operated at high speeds in dry atmosphere is another source of danger from static discharges.

The belt may become electrified by friction of the atmosphere on the belt, slippage over the pulley and bending of the belt. Since this potential has been measured and found to exceed 50,000 volts in many cases, it can be readily seen that belt driven machinery, if possible, should be located outside the hazardous area.

If the machine operates in an area of high humidity, the surface of the belt will become semi-conducting, and no trouble will be experienced from sparking. In a dry atmosphere some means must be used to drain the charge on the belt off to ground before a high potential is built up. *The use of static combs is a dangerous practice in a hazardous atmosphere because the separation between the teeth of the comb and the belt will cause sparking.* In our own process units we have found the best results to be given by an arrangement as shown in Figure 4. This makes use of a number of coil springs or chains in actual contact with the belt. Maintenance will be higher than on one using static combs, but the danger will be greatly reduced.

In addition to sparking from a charged belt to nearby objects, *dangerously high potentials will be built up in the driving motor itself unless it is properly grounded.* This potential will often reach values high enough to cause failure of the insulation with resultant destruction of the motor. Here again properly designed grounding is the answer. Occasionally in motors equipped with sleeve bearings the oil used for lubrication will insulate the rotating part of the motor from the frame and potentials will be built up in the armature. *This can be prevented by the use of a leaf spring resting on the shaft and grounded to the frame.* In some cases it is possible to keep a belt discharged by using a belt dressing to which graphite has been added.

Conveyor belts present the same problems as belt drives and should be handled in the same way. If roller type conveyors are used, *the rollers should be of metal and the supports should be bonded and grounded.*

TABLE I

TANK GROUND RODS REQUIRED

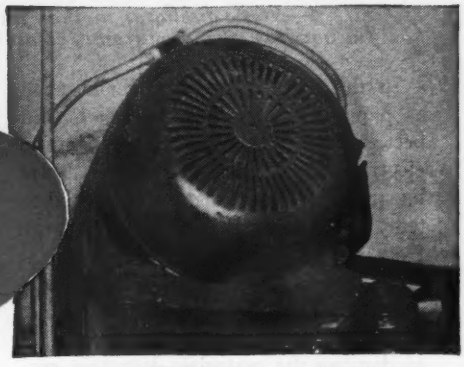
(No Ground Bus Installed Around Tank)

Diameter of tank	No. of Ground Rods
Up to 10-ft.	2
10-ft. to 20-ft.	3
20-ft. to 30-ft.	4
30-ft. to 40 ft.	5
40-ft. to 55-ft.	6
55-ft. to 70-ft.	7
70-ft. to 85-ft.	8
85-ft. to 100-ft.	9
100-ft. to 120-ft.	10

Note: One additional ground rod must be installed at each swing joint.

Century TEFC Motor mounted on a drill press — near the floor, where metallic dust, dirt, and chips can fall on it — yet the vital parts are protected.

Century TEFC Motor mounted on a milling machine. Dirt on outside of fanguard is result of operation where air contains metallic dust and coolant spray.



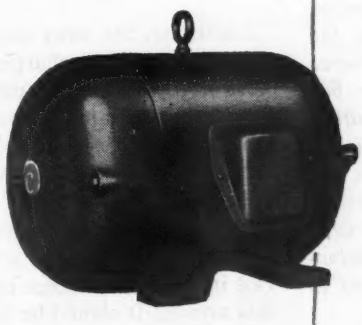
Century TEFC Motor mounted high on top of a boring machine. It's out of reach and probably gets little attention, yet protected against coolant mists and oil-laden dusts by Century TEFC design.

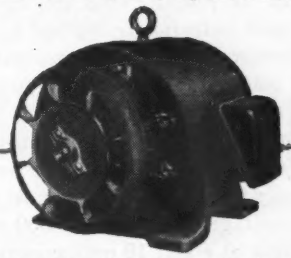
Destructive Atmospheres Require the Protection of CENTURY TOTALLY ENCLOSED FAN COOLED MOTORS!

The illustrations of Century TEFC Motors in use shown here are typical examples of machines on which these motors can maintain production despite adverse atmospheric conditions. Where the air is charged with substantial quantities of metallic or abrasive dusts, coolant mists, or oil-laden factory dusts, Century TEFC Motors give the protection that means constant uninterrupted production.

The vital parts of the motor are isolated from the outside atmosphere by a sealed inner frame. A large fan blows a blast of cooling air around the frame and the bearings — to keep the motor temperature well within safe operating limits.

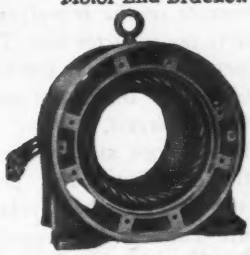
For maximum protection that will keep your machines on the job, get all the facts about Century Totally Enclosed Fan Cooled Motors. Call in a Century engineer; he may be of assistance.





Century Totally Enclosed Fan Cooled Motor with the heavy, pressed steel fan cover removed.

Century Totally Enclosed Fan Cooled Motor End Bracket.



Century Totally Enclosed Fan Cooled Motor Frame and field winding showing the air passages.

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434

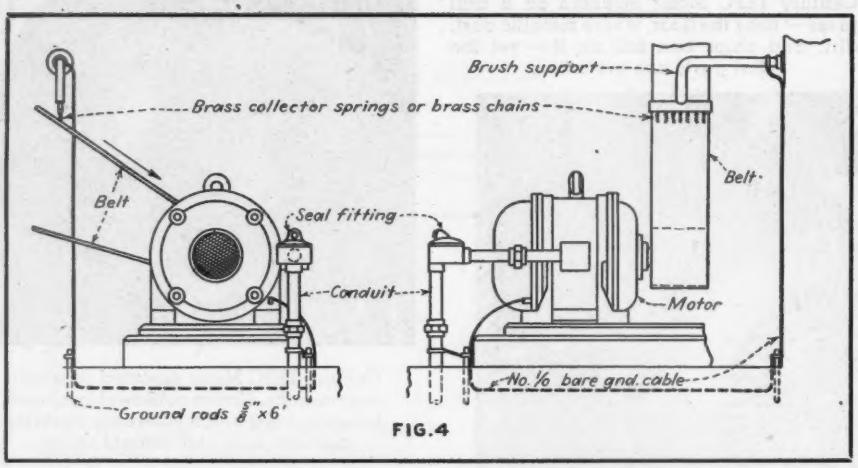

FIG.4

FIG. 4—Static discharge method for belt driven machinery. Note careful bonding of motor frame, conduit and collector spring holder.

In the processing of material such as paper or thin plastic which is run between rollers at high speed, static electricity, in addition to being a fire hazard, may also cause the material to tear. The removal of a static charge from paper, thin rubber or other material of this type is usually very difficult. Contact type collectors do not operate fast enough and they are apt to damage the material. For this reason the approach to the problem is from a different angle. *The static potential on the substance is measured as accurately as possible and an equal and opposite potential is applied by means of inductor bars in close proximity with the material.* This charge neutralizes the static charge and reduces the material potential practically to zero.

For this purpose an a-c source is usually used with a transformer to raise the voltage to around 20,000 volts—a current of about 10 milliamperes being sufficient in most cases. The transformer should have a high reactance in order to limit the current in case of short circuit. One end of the high voltage transformer should be grounded and the other end connected to the inductor bar. *In hazardous atmospheres the connection to the inductor bar should not be direct but should rather be by means of a metal ring slipped over a heavily insulated cable. The ring connects to the transformer and the cable to the inductor bar. The voltage is then applied to the bar by induction and further limits the current in case of short circuit.*

Linoleum floors are another source of static electricity and preferably should not be used where volatile materials are handled. In general, testing of the floor may be done by means of a 20-lb. steel block about three inches square placed on a slightly moistened portion of the linoleum. If the resistance, when tested to ground with a Megger is 150,000 to 200,000 ohms or less, the floor can usually be considered safe. The use of shoes made of conductive material is not satisfactory although special floor coatings which reduce the resistance to ground of the floor will be of some value.

TABLE II

TANK GROUND RODS REQUIRED

(Ground Bus Installed Completely Around Tank)

Diameter of tank	No. of Ground Rods
Up to 20-ft.	2
Up to 50-ft.	4
Up to 120-ft.	6

Note: One additional ground rod must be installed at each swing joint.

Lightning and Transients

Lightning, the most common example of the static discharge, is also the most costly to lives and equipment. Years of research, however, have evolved many effective methods of combating destruction from this source and there is a great amount of sound, practical data available dealing with its control. The subject as a whole is too vast in scope to be taken up in detail in this article. It should be borne in mind that here again effective grounding of all lines and equipment, either directly or through arresters, is of prime importance.

There is a phase of disturbances from lightning and switching surges which, in most cases, does not receive the attention it merits. In the usual electrical installation great care is taken to adequately protect transformers and substations against transient surges, but *in general the protection of rotating machinery connected either directly to an overhead line or indirectly through transformers is neglected.*

Our own experience has shown that *rotating machine protection is fully as important as transformer protection.*

The protection of rotating machinery is not as simple as is the protection of transformers. Because of the low impulse strength of machine insulation as compared with transformer insulation, the use of lightning arresters alone is not sufficient. It is necessary to *supplement lightning arresters with protective capacitors.*

When a transient voltage is impressed on the terminals of a rotating machine, high frequency charging current will flow between turns of the machine and from the turns to the slot sides. This current will not flow under normal conditions because the normal 60-cycle frequency is too low. In both delta and wye connected machines the result of this charging current will usually be to *double the voltage impressed on the winding.*

Use of the protective scheme shown in Figure 5 has been 100 percent effective on every motor to which it has been applied. To date we have not had one case of failure of a protected motor.

The capacitor is for reducing the peak of the transient wave and the special arrester limits the value to which the capacitor may be charged.

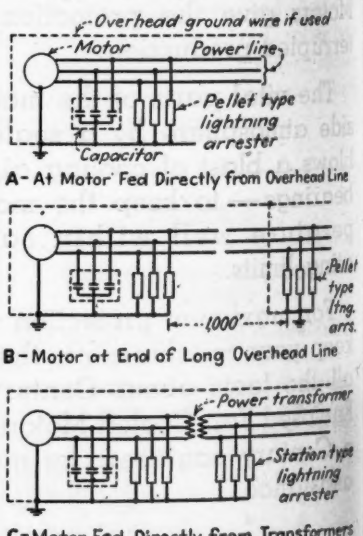

FIG.5

FIG. 5—Surge protection diagrams for motors connected directly to overhead lines or to a transformer. Where connection to overhead line is by underground cables, cable sheath should be grounded and lightning arresters installed both at the motor and the overhead tap-off.

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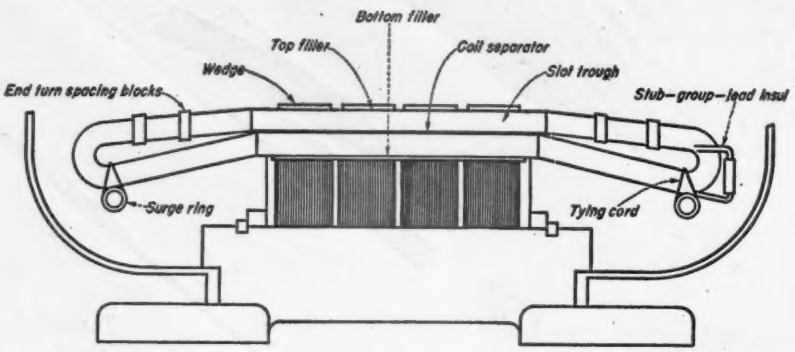
DATA SHEET

The number at the right is a classification for convenience in filing and for a future data sheet index

K9

Guide For Stator Rewinding Materials

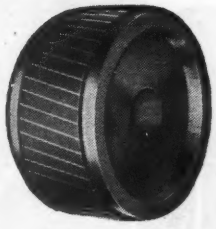
For Standard Class B Mica-Glas Coils and Silicone Mica-Glas Coils



TYPE	LOCATION	SEMI-CLOSED SLOT MACHINES		OPEN SLOT MACHINES	
		FOR STANDARD CLASS B MICA-GLAS COILS	FOR SILICONE MICA-GLAS COILS	FOR STANDARD CLASS B MICA-GLAS COILS	FOR SILICONE MICA-GLAS COILS
SLOT	Slot Trough	Mica-Glas 8A10	Silicone Mica-Glas 8A64	None—If necessary, use uncut mica or stiff varn. glass.	None—If necessary to tighten coil in slot use uncut mica.
	Bottom Filler	* * * * *	* * * * *	Canvas Base Bakelite 8A314 Glass Base Bakelite 8A317 Moulding Mica 8A29, 8A31	Glass Base Silicone 8A322 Glass Base Melamine 8A321
	Separator	Oiled Asbestos 8A311	Silicone Varn. Glass 8A68-8A72	Same as Bottom Filler Above	Same as Bottom Filler Above
	Wedge and Top Filler	Canvas Base Bakelite 8A314 Glass Base Bakelite 8A317	Glass Base Silicone 8A322 Glass Base Melamine 8A321	Canvas Base Bakelite 8A314 Glass Base Bakelite 8A317	Glass Base Silicone 8A322 Glass Base Melamine 8A321
CORE	Surge Ring	* * * * *	* * * * *	Mica Tape 8A1 Treated Glass Tape 8A705	Silicone Mica-Glas Tape 8A77 Silicone Glass Tape 8A706
END.	Spacing Blocks	* * * * *	* * * * *	Canvas Base Bakelite 8A314 Glass Base Bakelite 8A317	Glass Base Silicone 8A322 Glass Base Melamine 8A321
	Between Phase Coils	Mica-Glas 8A10, 8A11, 8A32	Silicone Mica-Glass 8A64, 8A65, 8A70	* * * * *	* * * * *
	Tying Cords	Treated Glas Cord 4A16 Flax Cord 4A1	Silicone Glass Cord 4A18	Treated Glass Cord 4A16 Flax Cord 4A1	Silicone Glass Cord 4A18
COIL CONNECTIONS	Stub, Group, and Lead Connections	Varn. Glass Tubing 9A1, 9A2, 9A3 Mica Tape 8A1 Treated Glass Tape 8A705	Silicone Glass Tubing 9A11, 9A12, 9A13 Silicone Mica-Glas Tape 8A77 Silicone Glass Tape 8A706	Mica Tape 8A1 Treated Glass Tape 8A705	Silicone Mica-Glas Tape 8A77 Silicone Glass Tape 8A706
LEADS	For External Connections	Glass Braid Covered Cable Asbestos Varn. Cloth Cable	Flex. Copper Strands Slipped Thru 9A13 Silicone Tubing Silicone Rubber & Glass Cable AVC Cable Installed After Baking	Glass Braid Covered Cable Asbestos Varn. Cloth Cable	Flex. Copper Strands Slipped Thru 9A13 Silicone Tubing Silicone Rubber & Glass Cable AVC Cable Installed After Baking
SOLDERING SUPPLIES	Solder	100% Tin 2A72 95% Tin 5% Antimony 2A73 Hi-Temp. Alloy 2A75 Copper Fusion	Silver Solder 2A65 Hi-Temp. Alloy 2A75 Copper Fusion	100% Tin 2A72 95% Tin 5% Antimony 2A73 Silver Solder 2A65 Hi-Temp. Alloy 2A75	Silver Solder 2A65 Hi-Temp. Alloy 2A75
	Flux	Rosin Solution 2A54	Rosin Solution 2A54	Rosin Solution 2A54 Borax or Handy Flux	Rosin Solution 2A54 Borax or Handy Flux
VARNISHES Dipping	Winding	Long Life Synthetic Baking 2A151—Black; 2A100—Clear	Silicone DC 993	Long Life Synthetic Baking 2A151—Black; 2A100—Clear	Silicone DC 993
VARNISHES Finishing	Winding	Black Oil Proof Air Dry 2A98	* * * * *	Black Oil Proof Air Dry 2A98	* * * * *
	Frame	Blue Thalac Enamel 2A34	Heat Resistant Enamel 2A184	Blue Thalac Enamel 2A34	Heat Resistant Enamel 2A184

Data From National Electric Coil Company, Columbus, Ohio.

The Only Motor with a *Copperspun* ROTOR



Only in Fairbanks-Morse Motors will you find rotors centrifugally cast in *one piece*—and of *copper!*

The characteristics of copper make it the ideal rotor material. Copper has high electrical and thermal conductivity (twice as good as aluminum), greater strength, and low thermal expansion.

The indestructible copperspun rotor, with its better electrical characteristics, puts the new Fairbanks-Morse Motor far ahead of the times in stamina, in protection, and in versatility.

See a demonstration of what this motor can do for you. Write Fairbanks, Morse & Co., Fairbanks-Morse Building, Chicago 5, Illinois.

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Protected Frame—Excludes dripping liquids and falling particles.

Cross-flow Ventilation—Another exclusive feature. Air moves in both directions, providing uniform cooling—no hot spots.

Ball Bearings—Sealed in and protected.

Recessed Conduit Box—An innovation for neat installations in close quarters. Conventional box also provided.

Adaptability—Frame gives protection in any mounting position because the vented bearing brackets can be turned to four positions 90° apart. Reversible frame permits locating conduit box on either side.

Balanced Characteristics—A 40°C. motor with high efficiency and power factor, and excellent starting and accelerating torques.

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"75 to 100 Men Were Thrown Out of Work Every Time we had an Electrical Shutdown- then . .

We Discovered BUSS Fuses Would Cure Our Troubles"

. . . Mike Verder, Chief Electrician, McEwan Brothers, Whippany, New Jersey

HERE'S THE STORY:—"Some time ago we had trouble with fuses blowing on the main circuit which furnishes the power for a 150 horsepower motor. The motor operates pumps which force paper, in liquid form, to the paper machine. On an average of once a month, the fuses we formerly used would blow—causing a shutdown of the pumps, and consequently the paper machine. This meant wasting a tremendous amount of material that was in process and it meant that 75 to 100 men stood idle until the machinery could be put into operation again.

"When we examined the fuses that had opened the circuit, we found that they were not *blown* links but *burnt* links, that were caused by poor contact due to the vibration of machinery located nearby. Then we decided to try BUSS Super-Lag Fuses, and we certainly did profit by the change. We have had not one unnecessary shutdown since. This has meant a real saving in material, time, and money, plus increased production."

Paper Machine at McEwan Brothers, Whippany, N. J.

BUSS Super-Lag

Mr. Mike Verder, Chief Electrician, McEwan Brothers, Whippany, N.J.

Here is why BUSS fuses greatly reduce or entirely prevent needless blows

The fuse case is designed to insure good contact on the link, even when the fuse is renewed by an inexperienced person—and it is so designed that vibration or heavy overloads or the constant heating and cooling of the fuse will not permit poor contact to develop. Thus excessive heating which causes fuses to blow needlessly is prevented.

The fuse link used is the famous "BUSS Super-Lag." It has lag-plates attached to it. These give it a time-lag so long that it will reduce to an extent not possible with any other renewable fuse, the number of Shutdowns caused by needless fuse blows.

And Here Is How to Solve the "Shutdown Problem" in Your Plant

Pass the word along that all purchase records dealing with circuit protective devices should be immediately changed to call for BUSS Super-Lag Renewable fuses. Then, as fuses are replaced or new installations made, your plant will automatically get the benefit of the carefree, trouble-proof protection of BUSS Super-Lag fuses.

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Why BUSS Fuses Don't Blow Needlessly
10 FEATURES
in the design of the FUSE-CASE help make it possible.
and
The SUPER-LAG
development in the FUSE-LINK completes the job.

Fuses SOLD THROUGH WHOLESALERS

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READER'S QUIZ

TURBO GENERATORS

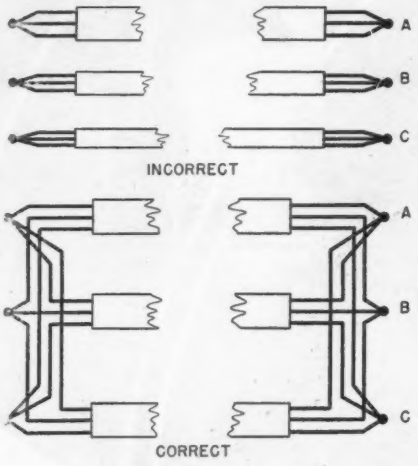
QUESTION 189—We have three 5000 kw. turbo-generators in our small power plant, which is one of three and which is used to supply a heavy lamp load and a small reactive load. These three units were recently flooded, after which they were removed and returned to the factory for drying. When put back into service, two of the units carried their full loads of 1560 amps. with maximum field excitation. The third unit, however, will not carry more than 1000 amps, with full field excitation. The power factor meters of the two "good units" read the same, but the p.f. of the defective unit reads about 10 percent higher. The instruments, control and motor have been thoroughly checked with the exception of the internal connections of the rotor. The units are 2300 volt, 60 cycle, 3600 rpm.

Since heavy cable was not available to connect the generator terminals to the 2300 volt station bus, adequate cross-section was obtained by three three-phase three-conductor cables for the 150 foot run to the bus.

Do you suppose the self inductance of these cables has anything to do with the generator not taking its full share of the load? If not, where is the trouble apt to be?—W.F.K.

A. TO QUESTION 189—From the data given, the turbo-generators are rated at 6200 kva. The defective unit is delivering only 4000 kva. This would indicate the machine was delivering only two-thirds of its rated output.

If the ammeter readings are balanced for each phase, that would eliminate one possibility of there being a whole phase inoperative. A power loss of over 700 kva. per phase in leads only 150 ft. long would soon become apparent in heating and smoke. That would eliminate the leads.



The output of a generator is dependent upon the input to the prime mover, and not merely upon field excitation. Since the electrical connections have been checked thoroughly, the turbine is open to suspicion. If steam flow meters are on each turbine, the charts should be carefully compared to see that the "defective" unit is receiving its rated amount of steam. Other things to check would be pressure, vacuum, if bleeding or extraction is in proper balance, if the main inlet valve is partially closed, etc. If superficial checking of steam piping and auxiliaries does not disclose anything out of line, the turbine casing should be lifted to check the condition of the blades.

When a generator is tied into a system, the power factor meter is a measure of how much the generator is "boosting" voltage. Increasing the excitation lowers the power factor of the unit and swings the pointer in a lagging direction. With the generator receiving full excitation and the prime mover not taking full steam consumption, a power factor nearer to unity than the "normal" machines would throw suspicion back at the internal connections of the stator.

It was not stated just how the 3 conductor cables were connected. The sketch shows a right and a wrong way. The differences in "cable efficiency" become greater if the cables are in separate iron conduits or have armors of magnetic materials. When the cables are cross-connected, they should be substantially the same length.—L.E.B.

A. TO QUESTION 189—There seems little doubt that the inability of the third unit to fully share the load is caused by the installation of cables which are different from those connecting the two other units to the common bus.

Suppose the newly-installed three, three-conductor cables are connected in such a way that each cable (that is, all three legs of each cable) is connected to one phase. Then, improvement should be possible by connecting one leg of each cable to one phase. In this case, each cable will carry the current of all three phases. There will be no sheath losses because the load within each cable is balanced. (The higher power factor of the third unit seems to indicate that such sheath losses exist with the present arrangement.)

If necessary, additional improvement may be possible by suitably interlacing the conductors of all three units, to equalize their mutual inductances.—L.F.R.

IDENTIFYING RUBBER COVERED WIRES

QUESTION 190—How can I tell the difference between rubber covered wires type . . . R, RW, RP, RH, and RU, at the outlet boxes one year after they are installed?—H.S.

A. TO QUESTION 190—If the various grades of rubber-covered wire have been manufactured since 1940 and in accordance with the requirements of the 1940 National Electrical Code, they should carry the identification mark on the outside of the conductor. Section 3005-f reads:

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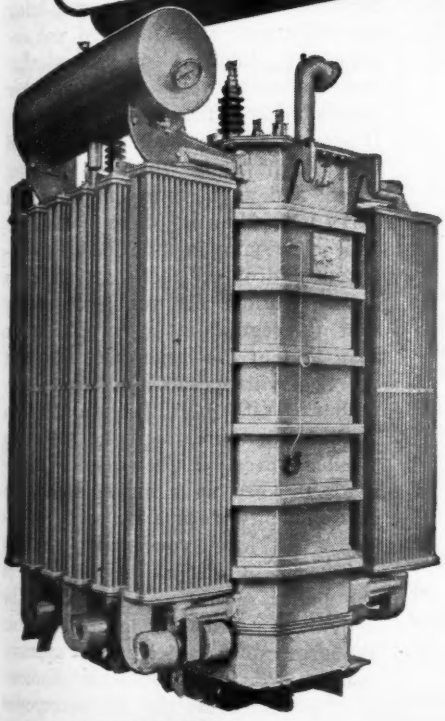

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Industrial transformer application requires a large number of designs or combinations of partial designs. These designs are standardized in general for manufacture. In this way, Wagner is able to meet customers' exact specifications and requirements, yet use designs which have been pretested and proved in service—your assurance of satisfaction.

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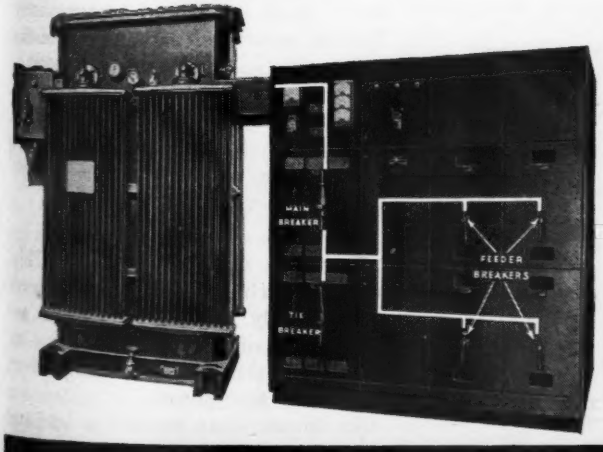
The Wagner Line Includes:

OIL-FILLED TRANSFORMERS **AIR-COOLED TRANSFORMERS**

UNIT SUBSTATIONS

NOFLAMOL TRANSFORMERS



T45-27

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"All rubber covered conductors shall have a readily identifiable permanent marking to indicate the type of insulation."

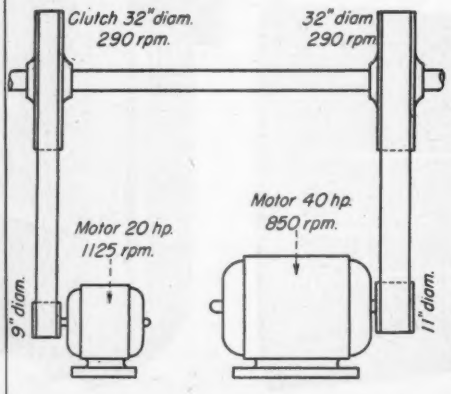
According to the Underwriters' Laboratories Standard for Rubber-Covered Wires and Cables, June 1940, paragraph 190, these wires shall carry the marking to indicate the type of insulation. The marking is to be continuous or to appear at intervals of not more than 1 foot for sizes No. 6 AWG and larger, and not more than 6 inches for smaller wires. Marking is to be according to the grade, R, RW, RP, RH, or RU.

On old wires there is no way of distinguishing the various types except in the case of RU conductors. These conductors have much thinner insulation so that for the same size wire the overall diameter will be noticeably less. —J.E.W.

TWO MOTORS TO DRIVE ONE SHAFT

QUESTION 191—We have a 20 hp. motor driving a line shaft to which more load is being added. We are now installing a 40 hp. motor to be connected to the line shaft to take care of the additional load. Can we leave the 20 hp. motor connected, with the clutch idle, and in case more power is needed, connect it to the shaft by closing the clutch? To do this, the small motor would be brought up to speed and the clutch closed with the line shaft running, powered by the 40 hp. motor.

The accompanying sketch shows motor speeds and other data on this hook-up. Will these motors work together as described without damage to either? If not, why?—C.B.J.



A. TO QUESTION 191—You indicate that with your 20 horsepower motor rated at 1125 rpm. and using a 9 inch diameter pulley and a 32 inch diameter clutch pulley on the line shaft, a speed of 290 revolutions per minute was obtained. If the motor kept up its speed and the diameters are as indicated, you should have a shaft speed of approximately 316 revolutions per minute. Therefore, it seems that loading this motor causes an additional slip of approximately 7½ percent. The 40 horsepower motor running at 850 revolutions per minute has an 11 inch diameter pulley and with a 32 inch diameter driven pulley, the speed of the shaft would be approximately 292 revolutions, assuming no additional slip.

Your plan is to drive the shaft with the 40 horsepower motor, then to bring the other motor up to speed and engage the clutch. You ask whether these motors would work together satisfactorily without damage to either. It seems that the smaller motor would tend to drive the shaft at a higher speed and that, therefore, it might carry more than its share of the load. Since carrying a full load has apparently dropped the shaft speed to 290 revolutions per minute, it may be that its regulation is enough poorer than that of the larger motor so that the two will operate satisfactorily together. With the difference less than 10 percent, there might not be much trouble, even if the smaller motor tends to keep up a higher speed. If any difficulty does arise with an increase in load, conditions could be improved by decreasing the size of the pulley on the small motor or by providing a somewhat larger pulley on the large motor; a decrease of approximately 2/3 of an inch in diameter of the pulley on the 20 horsepower motor or an increase of approximately 9/10 of an inch in the diameter of the pulley on the 40 horsepower motor.

This is on the assumption that the characteristics of the two motors are the same, that is, that the same percent slip will occur at the same percent of full load.—J.E.W.

A. TO QUESTION 191—This clutch arrangement will work satisfactorily. We have a similar arrangement of a 100 hp. stand-by for use on a coal conveyor normally driven by a 150 hp. motor.

In winter when the belt is cold and sometimes iced, it is necessary to use the auxiliary motor to start the belt and carry until the belt has warmed enough to become softened. The clutch is then thrown out and the motor shut down.

Our problem is starting torque and of course we start both motors at the

same time with the clutch engaged. The questioner's problem is a little different, but with proper care in selection of speeds, type and size of clutch for the job, he should have no difficulties.—C.A.W.

A. TO QUESTION 191—We assume that the two motors shown in the sketch are induction motors, and since the 20 hp. motor has a speed of 1125 rpm., we assume this is the full load speed and the synchronous speed is 1200 rpm. Similarly, we assume that the 40 hp. motor has a synchronous speed of 900 rpm., since the full load speed is indicated as being 850 rpm.

On this basis the line shaft speeds are figured as follows:

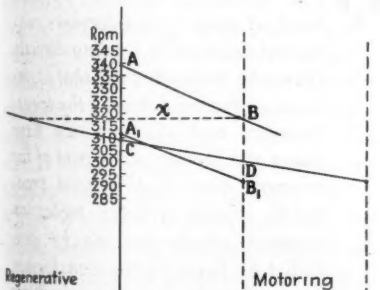
(A) 20 hp. $1200 \times \frac{9}{32} = 338$ rpm.
No Load Synch. Speed

(B) 20 hp. $1125 \times \frac{9}{32} = 317$ rpm.
Full Load Speed

(C) 40 hp. $900 \times \frac{11}{32} = 309$ rpm.
No Load Synch. Speed

(D) 40 hp. $850 \times \frac{11}{32} = 292$ rpm.
Full Load Speed

Plotting the speed-load curve for the 20 hp. motor is shown by curve A-B

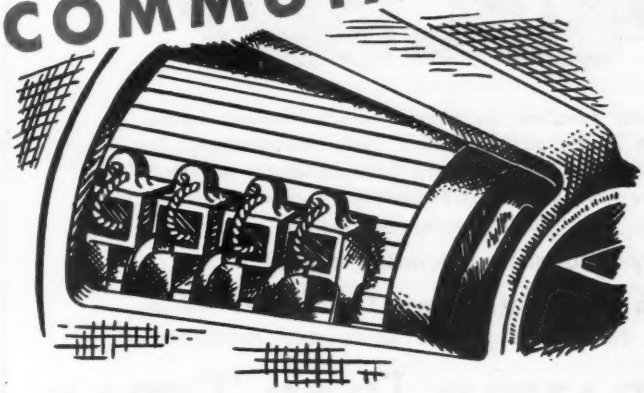


and the speed-load curve for the 40 hp. motor is shown by curve C-D.

Since the motors are connected to the same shaft, they are obliged to run at the same speed (assuming there is no belt slippage). If there was no external load we would expect the two motors would divide the load at 317.5 rpm. and the 20 hp. motor would be carrying pretty nearly full load overhauling the 40 hp. motor as indicated by the horizontal line X. If load was added to the line shaft, the 20 hp. motor would become overloaded since it is already carrying very nearly its rated load overhauling the 40 hp. motor, which acts as a generator. In order to get the two motors to divide the load properly, we suggest a pulley of 34.7 inch diameter for

which do you BUY . . .

BRUSHES OR COMMUTATION?



As above pictured, a BRUSH is a contact piece of conducting material which transmits current between rotating and stationary parts of the electrical machine which either generates or utilizes electrical energy. Therefore, COMMUTATION is the most important function of a BRUSH.

Many vitally important conditions must be overcome to achieve that perfect team work between Brush and Commutator or rings which makes for efficient commutation. *Identical motors often do not give identical performance.*

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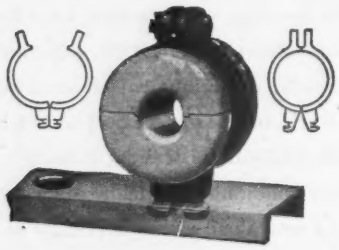

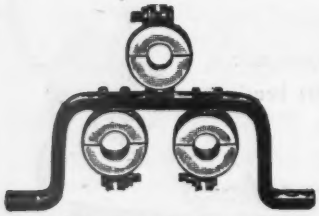

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the 20 hp. motor so as to make it run slower and this would make the 20 hp. motor speeds to be as follows:

$$A_1 - 1200 \times \frac{9}{34.7} = 311 \text{ rpm.}$$

$$B_1 - 1125 \times \frac{9}{34.7} = 292 \text{ rpm.}$$

This new speed-load curve A_1—B_1 indicates that when the 20 hp. motor runs at 292 rpm., it carries 20 hp. and when the 40 hp. motor runs at 292 rpm., it is carrying 40 hp.

Due to the difference in slope of the two curves, at very light loads the 20 hp. motor is overhauling the 40 hp. motor slightly. In order to get the loads to be exactly the same at all speeds, use a 34.5 inch pulley for the 20 hp. motor which would give the same speed at zero loads for both motors, and then add a slight amount of permanent resistance in the secondary of the 40 hp. motor in order to get the same slip at full load on both motors. This, of course, means a continual heating loss in this resistor, but the percent slip on the two motors is so nearly alike that it would not amount to very much.—R.F.E.

FEEDER FUSED AHEAD OF PRIMARY BUS

QUESTION 192—We have a bank of power transformers connected delta-delta feeding directly from the primary bus; that is, instead of fusing between the transformers and the bus, we have fused the feeder just ahead of the primary bus. Is this good practice? Would greater protection against single-phasing be provided by fusing each transformer lead; that is, by using six fuses instead of three as above?

As now connected, should one fuse blow, only single-phase would be supplied to the primary. Am I right in assuming that the secondary phase relationship would be zero, and that three phase motors could not start under such a condition? Would motors running at the time of such failure continue to run? What would be the secondary voltage and winding capacity?

If only one fuse blew, using six fuses (one in each transformer lead) what would be the resulting voltages and capacities?—W.B.M.

A. TO QUESTION 192—Under present conditions, blowing a

fuse in the feeder will make one transformer operate in parallel with two in series. The secondary of the one would have full voltage. Polyphase rotating apparatus, connected to either winding of the transformer bank would attempt to maintain the original polyphase conditions. (Induction motors would be somewhat less successful than synchronous motors.) The useful three-phase power output of the system would be reduced to something less than one-third of the combined ratings of the polyphase motors which were running at the time of blowing the fuse. Voltages would become unbalanced, torque would be decreased, and all equipment would overheat unless only lightly loaded.

A less complicated situation will arise if each transformer primary lead is fused separately. Loss of one fuse would cause the transformer bank to operate in open delta with an impedance connected across the legs of the secondary "V". System capacity would be reduced to 58 percent of the original transformer capacity. Some voltage unbalance would occur, however its seriousness depending upon the total load as well as the impedance of the dead transformer secondary.

The former protection method has less to recommend it than the latter.

Under present conditions, a blown fuse will result in a zero phase relationship (with two phases at approximately half voltage) if no motors are running. Motors already running would continue to turn, but at reduced capacity. If motors are already running, other polyphase motors will start if lightly loaded. If no polyphase rotating apparatus is running when a fuse is blown, the motors on the system will not be self-starting. They can be brought up to speed if not heavily loaded and their own inertia is overcome by mechanical means, such as turning them by hand.—L.E.B.

A. TO QUESTION 192—Answering the various questions in order:

(1) Fusing the primary bus is perfectly good practice, provided the fuses are small enough to properly protect the transformers.

(2) Much greater protection against single phasing would be obtained by fusing each transformer lead separately.

(3) You are correct—three phase motors could not start should one of your present fuses blow. Motors already running would probably continue to run on single phase, but if loaded to anywhere near their rating, their running protective devices should

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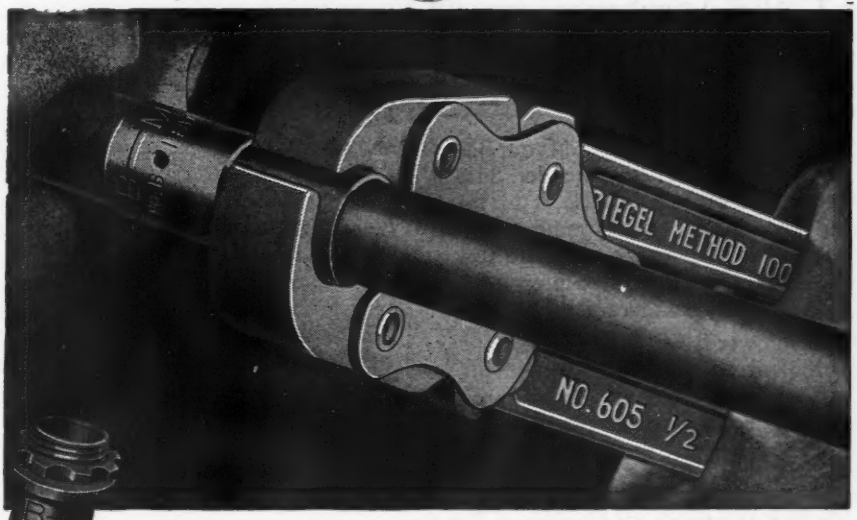

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operate and stop them. The secondary voltages in this case could not be calculated since they would depend upon the amount and nature of the loads on the system.

(4) If one fuse in a six fuse setup blew, you would still get three phase power, from an open delta arrangement. Secondary voltages would be disturbed but very slightly, and the amount of power available from the bank would be 86 percent of the capacities of the two transformers remaining in service.—W.B.S.

A. TO QUESTION 192—In using six fuses, instead of three in the primary, you get the benefit that should one transformer burn out at a time when the remaining load will be less than about 58 percent, it will not stop production, because the load will work on the open delta remaining connection. Three fuses would mean a loss in production until the burned out transformer is disconnected and the fuse replaced.

To get the above benefits, we must also have four fuses in the secondary circuit because the burned out transformer will blow the two primary fuses and one or both secondary fuses belonging to its neighboring transformers, since the good transformer fuses carry their normal load plus the load caused by the short across the open delta, so you remove the fuses of the burned out transformer and replace the fuses of the good transformers to restore service on the open delta connection. For safety sake, you will have to move the ground from the middle of one transformer to a junction of two transformers and use a solid connection at that point of two transformer leads and a ground lead. As far as protection for transformers three or six fuses are about alike unless the primary or secondary delta is opened accidentally, in which case there will be available 1.73 times normal current for one of the transformers.—H.S.

A. TO QUESTION 192—I would not consider your connection good practice with a delta-delta bank.

It is better to fuse each transformer separately so that if one fuse blows it only cuts out one transformer and the remaining two continue to operate as three phase open delta, sometimes called V connection.

With an open delta, the loss of one transformer will have no appreciable effect on the system; the voltage of the phases, the phase relation (120° apart) and the input will remain practically the same, and the 3 phase motors will operate o.k.

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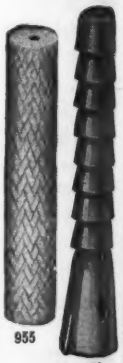

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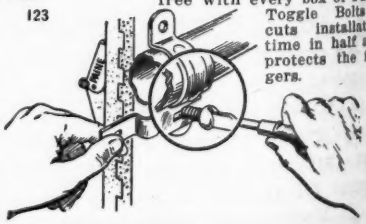

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The only effect is a change in the kva. of the transformers. Assuming the load is balanced, say 100 kva., in each transformer, 300 kva. in all, the load in each of the remaining transformers will now be 100 x $\sqrt{3}$ or 173 kva. If this does not cause overheating, you can continue to operate.

If the overload on the transformers is 60 percent, they will operate for two hours at a room temperature of 30° C. without damage. If only 30 percent, they will operate for four hours without damage. If the full load kva. is not exceeded, you can operate indefinitely without the third transformer.

With your present connection the loss of one fuse cuts out two phases. With single phase the 3 phase motors, if running, will continue to operate at a reduced speed if lightly loaded. Their regulation will be very poor and they will have low torque and may open the overload circuit breaker or "pull out". If at rest they will not start when power is applied. They will make a humming noise.—A.E.T.

A. TO QUESTION 193—If the transformer bank mentioned is the only bank connected to the primary bus, locating the fuses between the feeders and primary bus should be satisfactory.

I do not believe that there is any advantage to be gained by fusing each transformer leg. If a fault occurs on any one phase, two fuses are apt to blow and the result would be the same single phase condition which exists if only three fuses were used.

Three phase motors will not start on single phase; however, motors which are running will continue to run unless they are very heavily loaded in which case they may overheat. In some cases, where several motors are running single phase on a three phase system, it may be possible to start other motors connected to the same system. This is because the motors running generate sufficient voltage across the other two phases to start the motors which are not running.

The secondary voltage across the good phase might be slightly low due to the extra load. The voltage on the other two phases would be zero except for the voltage induced by the motors which were running. This voltage would depend on the number and size of motors left running and the size of such other load which might be connected to the same bus. The capacity would be one-third normal.

If one fuse of the six blew the capacity would be two-thirds of normal capacity. If this capacity were not exceeded, the voltage should be approximately normal.—F.C.

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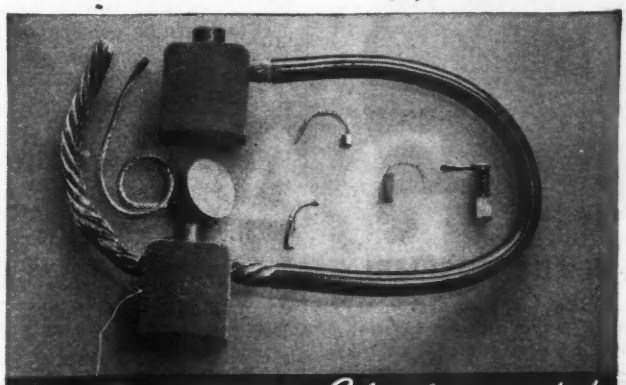

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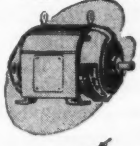

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QUESTION Q8 —We have an application involving an a-c generator with its switchboard located at a distance of about 75 feet from the generator. There are 6 leads to be run from the generator to the switchboard so that the connections can be made delta at 2300 volts or wye at 4000 volts.

The generator is rated 300 kw. at 80 percent power factor. 2300/4000 volts. What I would like to know are the formulae for determining:

1. The kva. rating of the machine.
2. The armature currents when connected delta.
3. The armature currents when connected wye. (This is a revolving field generator.)
4. The line currents both to the switchboard and beyond the switchboard when connected delta.
5. The line currents both to the switchboard and beyond the switchboard when connected wye.—G.S.E.

QUESTION R8 —We have twenty-five 220 volt 3 phase series delta connected four pole motors ranging from ¾ to 5 horsepower. The insulation is good and the motors are of a good make.

We wish to operate these motors on a 440 3ph circuit. Is it practical to reconnect the existing windings in a series star (wye) connection and operate them on the 440 volt service? What would be the characteristics of the motors under the new connection? Will it be necessary to rewind the motors for 440 volts?—T.B.B.

QUESTION S8 —I would like to know the methods used by electrical repair shops to draw stators from the casings of electric oscillating fans, 16 inches and smaller. Due to cords breaking where they enter the casing, it is desirable to remove the stator (which is pressed into the casing) without damaging the winding. I have done this by tapping the holes (through which the assembling rods pass) with a 10-24 tap and using a piece of 4¾ inside diameter seamless steel tubing, and a ¼ inch steel plate drilled to match these holes, the seamless steel tubing being 3½ inches long and making draw bolts 5½ inches long threaded 1 inch (10/24) on the end screwing into the stator and 3½ inches of thread on each bolt for drawing purposes. This method is a very slow and laborious one. The same bolts are used for drawing the stator back into the casing after a new cord is attached. Above given dimensions apply to 16 inch fans.—H.C.S.

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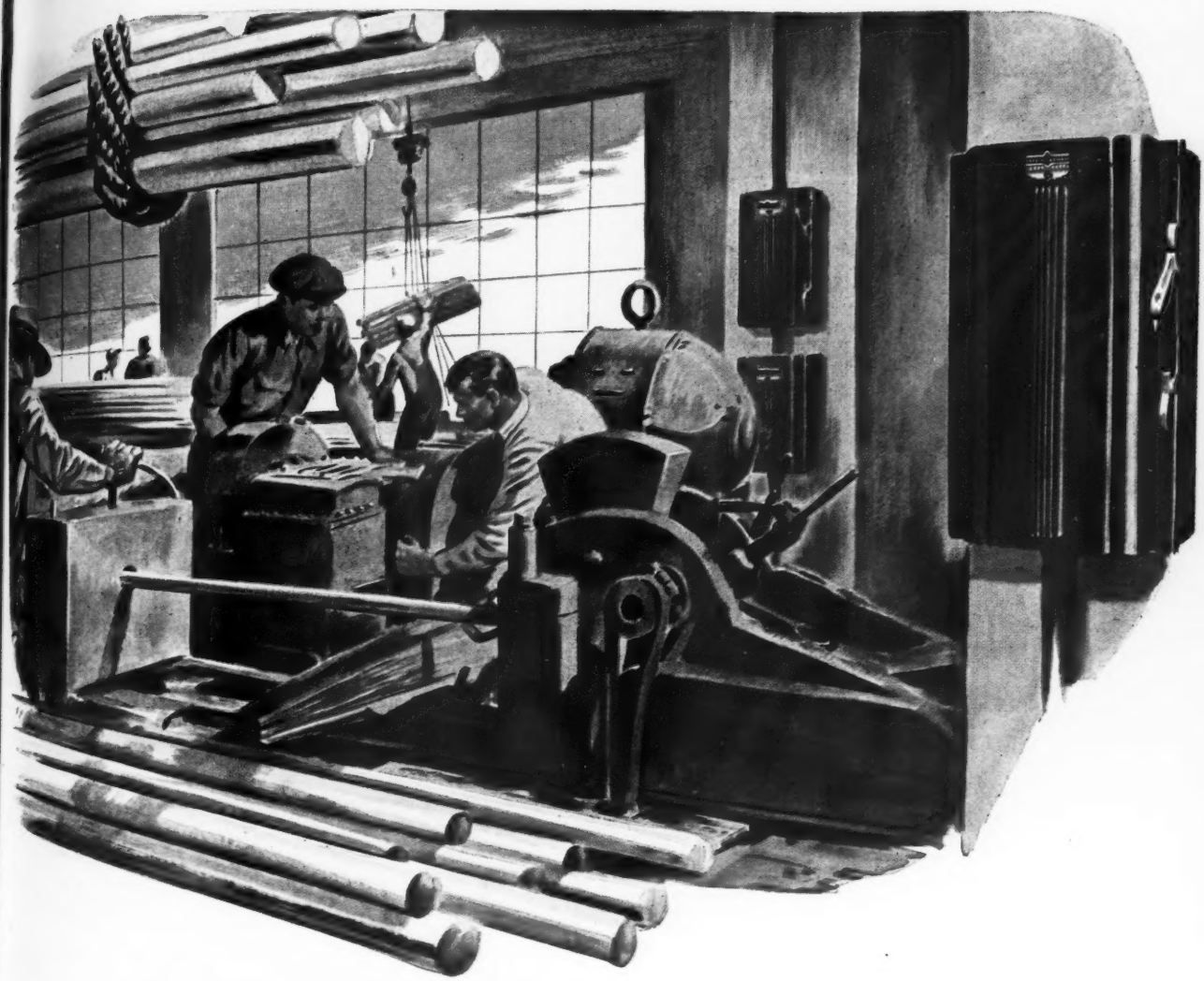

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Cutler-Hammer engineers found the answer to this problem of welded switch contacts, strangely enough, within the "nothing to do" life which all safety switches lead. They found that safety switches were far from idle during the months and months of seeming inactivity while they were simply standing guard for a possible emergency. During all this time, hour after hour, the switch parts were carrying *all* the power to the machines they were protecting. This flow of power generated much unavoidable heat, which literally *baked* the life out of the switch mechanism. This baking caused the switch contacts to gradually relax their grip on the blades which they held so tightly when new. This lessening contact pressure produced sparking . . . then arcing . . . then *welding* of the contacts. Here, then, was the secret of most safety switch troubles. Internal heating, *time-welded* contacts! Today an entirely new line of Cutler-Hammer Safety Switches is ready to bring your men and equipment protection worthy of your insistence. Specify Cutler-Hammer and refuse any substitute. Carried in stock by recognized electrical wholesalers everywhere. CUTLER-HAMMER, Inc., 1319 St. Paul Avenue, Milwaukee 1, Wisconsin.

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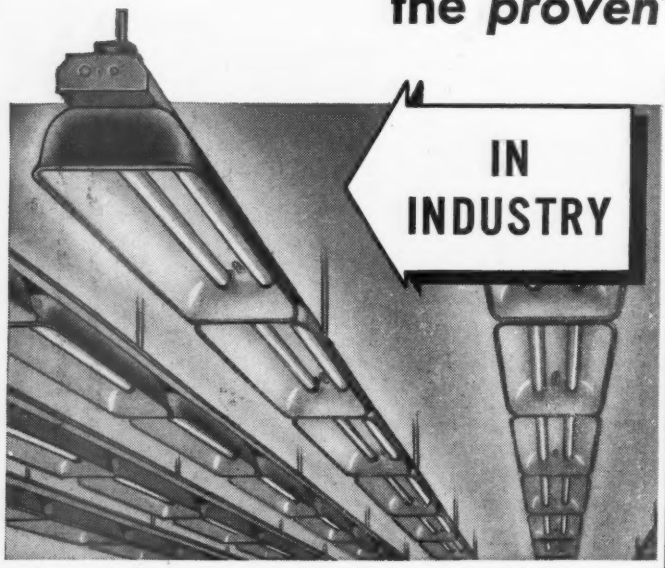

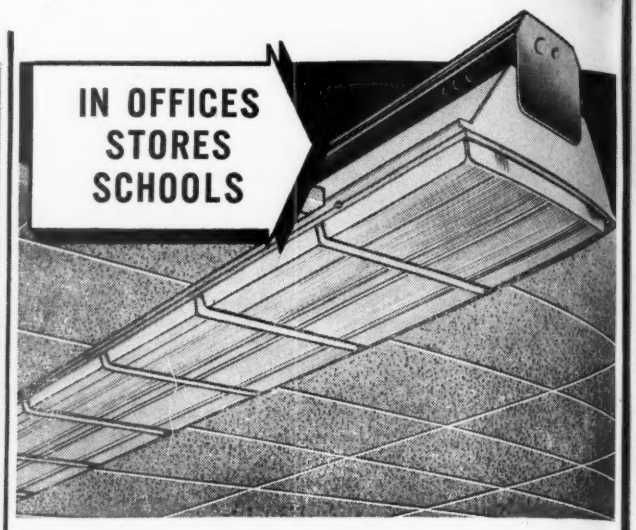

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ROLLING MILL DIVISION
Phosphor Bronze and Brass
in Sheets, Strips and Rolls

WAR CONTRACTS DIVISION
War Materiel

FOUNDRY DIVISION
Non-Ferrous Metal Castings

MOTOR SHOPS

MODELS HELP TRAIN NEOPHYTES

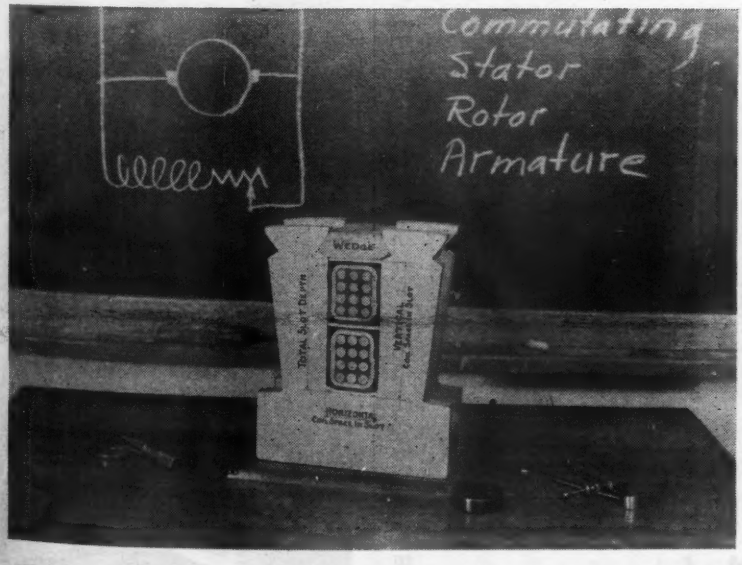
Training novices in the art of rewinding electric equipment is a pretty tough job. Have you ever tried to tell someone who has never seen a field coil or an armature coil just what these items are and the purpose they serve? Or, have you ever tried to show someone how to make the coil connections in a motor? To demonstrate the latter, Frank Willey, Cincinnati motor repair specialist has developed a large plywood dummy rotor with short pieces of wire that can be inserted to simulate various coil end positions in an armature.

To demonstrate the former—the actual coil positions in the armature—the supervisory staff and instructors at the National Electric Coil Company, Columbus, Ohio, one of the largest specialists in coil manufacture, have developed a model of an armature slot with its component parts. The device, shown in the accompanying illustration, is used to acquaint newcomers with trade terminology and the practical assembly of wires and insulation into coils that will be installed in the slots of a motor. To National this is an important phase of the training, for their employees wind and insulate thousands of different types of coils.

As reported in "Coil Talk" by William N. Reese, Superintendent of National Electric Coil Company's Columbus factory, the core laminations of the model are made of plywood. Dowel pin stock is used to simulate the conductors with the outer edge of the pins inked to represent the conductor insulation. Coil stiffeners are made of heavy pressboard. A study of the photograph will show that these stiffeners are in a vertical position in the top portion of the slot and horizontal in the coil at the bottom of the slot. The coil slot wrapper ground insulation is represented by two turns of white felt and a wrap of black felt simulates the outside binding tape of the coil.

The horizontal coil space—or slot width—is now completely filled, but additional materials are required to fill the vertical space. White felt is used as a filler in the bottom of the slot; as a separator between coils; and as another filler under the wedge at the top of the slot. A maple slot stick—the wedge—completes the demonstration assembly.

Such visual-education aids have made a vast contribution to the quick and thorough training of newcomers in the technical field.



Effective training aid, this model of an armature slot clearly portrays the construction features of coils and core slots that receive them. It was designed and used at the National Electric Coil Company plants for training new help.

CONTROLLING SPEED OF COIL WINDER

High speed war production increases maintenance problems. War plants have needed outside assistance in maintaining machinery, motors, control and similar equipment. Repair shops, geared to handling peacetime repairs, have been taxed to capacity with work during the war. In some communities, such repair work has greatly exceeded local facilities, creating a demand for new repair shops.

Use of jack shaft permits slow speed on coil winder, using an available high speed motor. Robert Dodge, veteran coil winder, is shown operating this machine in the Evans Motor Repair Shop.

Such has been the case in Utica, New York. Recognizing this problem, T. T. Evans decided to open up a new motor repair shop to assist the hard-pressed maintenance departments of the local war plants. The Evans Motor Repair Shop was thus formed and opened in November of 1944.

Opening up a new business during war proved to be quite a problem. Priorities which were available covering capital equipment was no assurance that the equipment could be obtained. For example, Evans Motor Repair Shop was able to obtain a coil winder, with head for winding coils up to 28 inches in length. But a suitable slow speed motor could not be promised for delivery for several months on the available priority.

T. T. Evans believes in the old adage "Necessity is the mother of invention".

RUBBER POWER CABLES • VARNISHED CAMBRIC CABLES • PERMACORD • LEAD-ENCASED AND PARKWAY CABLES • SYNTHOL WIRES • WELDING CABLES • SHIPBOARD CABLES • IMPERIAL NEOPRENE JACKETED PORTABLE CABLES • ARMORED CABLE • CRESFLEX NON-METALLIC SHEATHED CABLE • SERVICE CABLE • CRESCORD • BUILDING WIRE

CRESCORD

RUBBER JACKETED PORTABLE CORD

FOR LONG SERVICE ON TOUGH JOBS

CRESCORD comprises two, three or four flexible copper conductors, with color-coded, heat-resisting, rubber insulation under a tough, synthetic rubber jacket. It is flexible, highly resistant to abrasion, crushing, cutting, water, weather and sunlight.

Type S. CRESCORD has a heavy jacket for maximum life on portable drills, tools and industrial equipment.

Type SJ CRESCORD has a lighter jacket for use on household and office appliances. It is made in sizes #18 and #16 AWG only.

Type SV CRESCORD is a small, light, extremely flexible cord for use on household vacuum cleaners. It is made in Size #18 AWG only.

CRESCENT

WIRE and CABLE

CRESCENT INSULATED WIRE & CABLE CO.

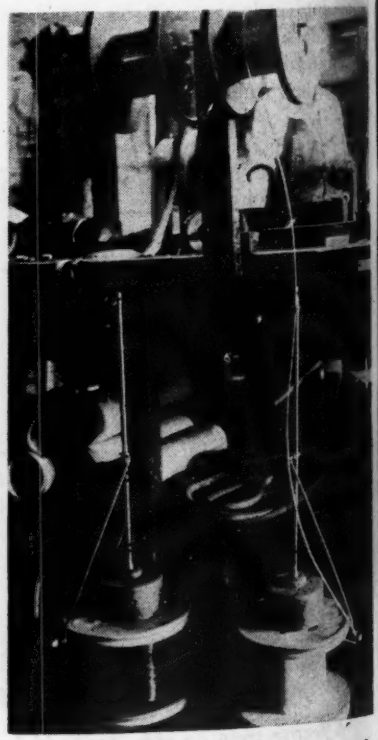
TRENTON, N. J.

It was urgent that he get his new shop into operation without delay, if he was to aid in the critical repair situation to keep war plants operating around the clock at top efficiency. He had in stock a one hp., 1760 rpm., 60 cycle, 110/220 volt motor. A larger hp. motor had been recommended for the coil winder. Evans decided he could use a jack shaft and adapt his single hp. motor to the coil winder.

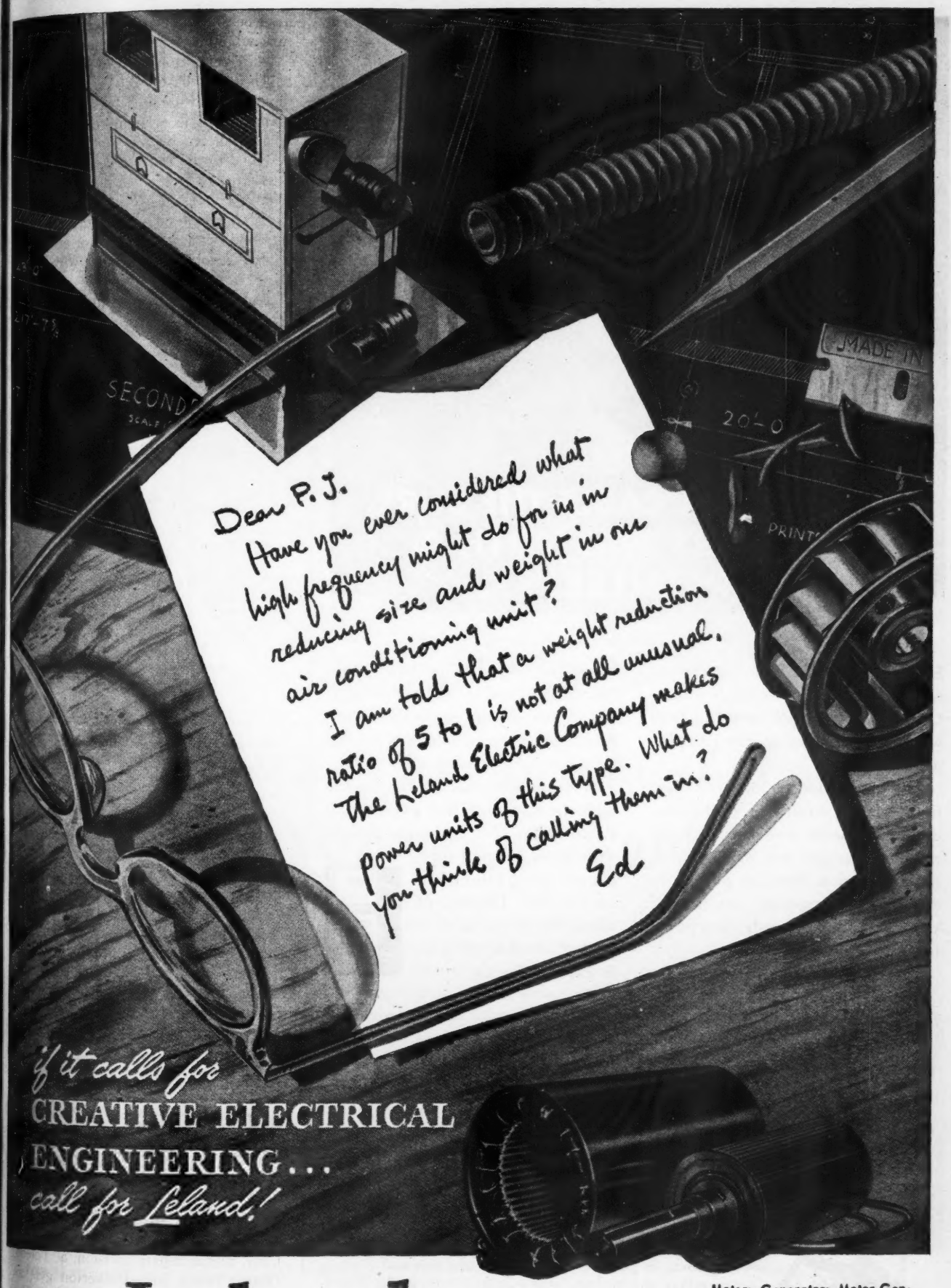
A wooden horse base was made for the winder. The jack shaft was installed below the top supporting members of the winder base. The motor shaft was equipped with a 2½-inch pulley for one-belt drive to an 8-inch pulley on the jack shaft. A three-belt drive was then connected between a 4-inch pulley on the jack shaft and the 10-inch pulley on the coil winder shaft. This assembly has provided the necessary slow speed, and the single horsepower motor has proved to be adequate from the power standpoint. Evans was thus able to get his shop into operation without delay, and has since been busy with repair work for the hard pressed war plants of his community.

REEL PAYOUT DEVICE

As designed and built by E. Maguin of the AAA Electric Motor Service of Los Angeles, his wire dereelers are based on old Model A Ford generator casings merely set on the reels without fastening from which the wire is to be taken. These reels are placed on the



Wire dereelers are mounted on reels behind the work bench. Empty reel idlers above, on bench.


Dear P. J.
Have you ever considered what high frequency might do for us in reducing size and weight in our air conditioning unit?
I am told that a weight reduction ratio of 5 to 1 is not at all unusual. The Leland Electric Company makes power units of this type. What do you think of calling them in?
Ed
if it calls for
CREATIVE ELECTRICAL
ENGINEERING...
call for Leland!

Motors, Generators, Motor Generators and Voltage Regulators

THE Leland ELECTRIC COMPANY

DAYTON, OHIO • IN CANADA, LELAND ELECTRIC CANADA, LTD.... GUELPH, ONTARIO

Simplify and speed cable installation work with a GREENLEE Cable Puller. Cut costs on each job with this fast-working, one-man-operated equipment.

And the GREENLEE does your work right! Clamps directly on to the conduit, *pulls straight out* to prevent loosening of hangers and damaging of cable insulation. Provides pull up to 7,500 lbs. Two speeds—one for fast pull, the second for steady, extra power for heavier work.

Easy to carry, easy to set up, the GREENLEE Cable Puller draws cable through all conduit: straight or bent, open or covered, on long or short runs. Attachments are available for pulling from concealed conduit also.

Save time, labor and trouble—install cable the easy way—with a GREENLEE Cable Puller. For complete details write today for your copy of free Catalog 33E. Greenlee Tool Co., Division of Greenlee Bros. & Co., 1750 Columbia Avenue, Rockford, Illinois.

Get Ready with Greenlee!

REGISTERED TOOLS

GREENLEE

FOR THE CRAFTSMAN

HYDRAULIC BENDER—One man quickly makes smooth, precise bends in pipe up to 4½", rigid and *thin-wall* conduit, tubing, and bus-bars—with a GREENLEE Hydraulic Bender. Portable—easily carried to the job and set up—saves time and materials. Whatever your bending job, there's a GREENLEE to do it better, faster!

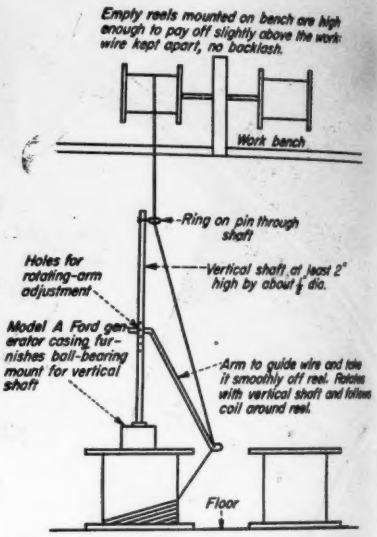
OTHER GREENLEE TIME-SAVING TOOLS FOR ELECTRICAL WORK

Hand Benders • Joist Borers • Electricians' Bits • Knockout Punches • Pipe Pushers

floor behind the bench where the armature winding is being done.

The generator casing provides a ball-bearing base. A vertical rod is mounted in it about 2 ft. high by ½ in. diameter. The vertical rod carries an arm as shown by the sketch, which is attached to the rod by passing through a hole at the top. It is then bent down so as to hang at an angle of about 25 or 30 degrees with the vertical. On the lower end of this arm, or sweep, is a ring through which the wire from the reel passes.

The wire is then run up through another ring at the top of the vertical

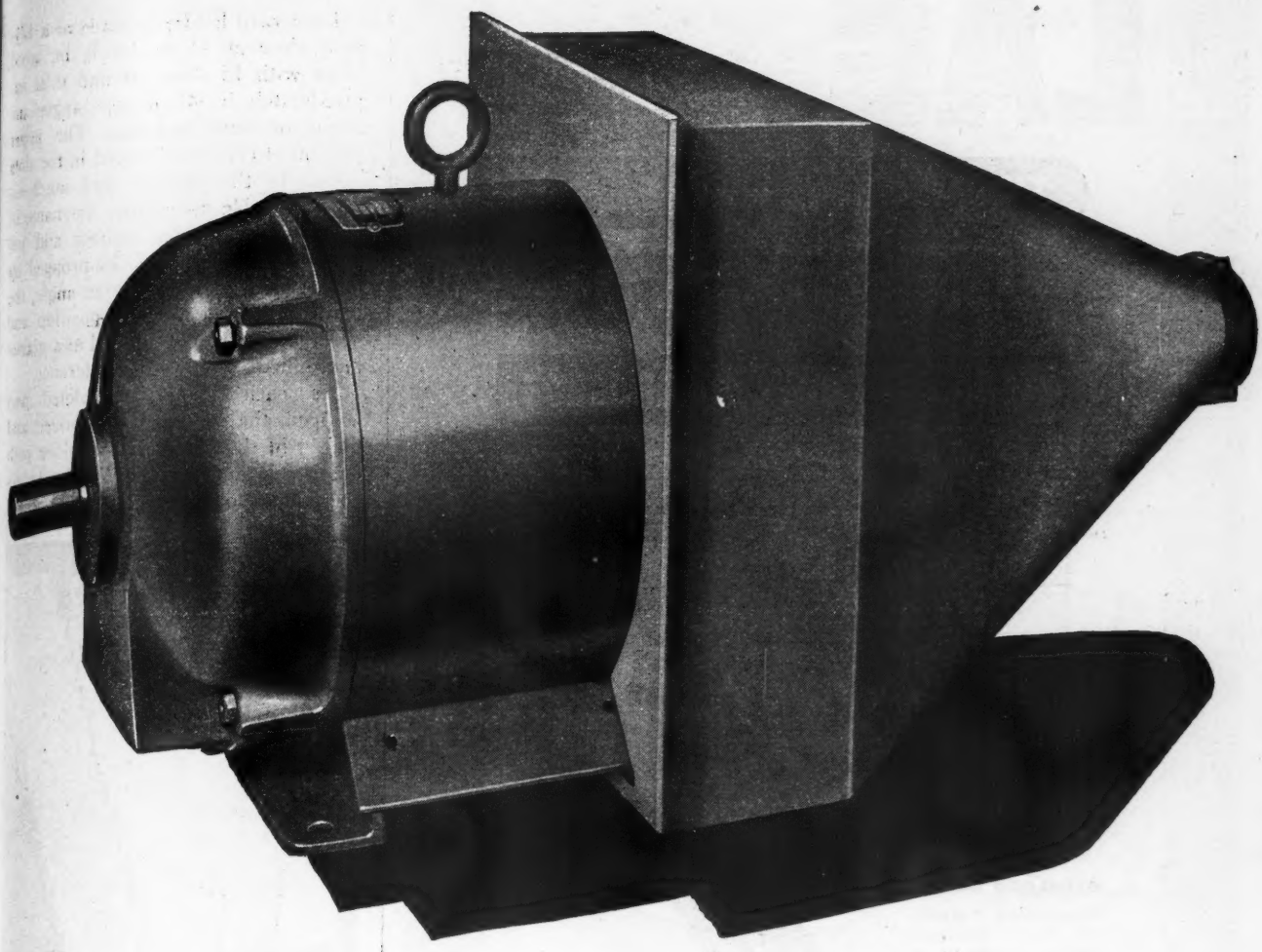

Empty reels mounted on bench are high enough to pay off slightly above the work; wire kept apart, no backlash.
Work bench
Ring on pin through shaft
Holes for rotating-arm adjustment
Vertical shaft at least 2" high by about ¼ dia.
Model A Ford generator casing furnishes ball-bearing mount for vertical shaft
Arm to guide wire and take it smoothly off reel. Rotates with vertical shaft and follows coil around reel.
Floor

Simple wire dereeler permits pay-off from idler reel without backlash.

shaft. From there the wire passes up and over an empty reel of large diameter fastened to the back of the bench on which the winding is being done. The wire comes over easily, with no backlash. The pay-off from the idler reel is practically on a level with the work being done. Consequently, the winder does not have to constantly "fight" the wire as is the case where it comes up from the floor or down from the ceiling at a sharp angle to the plane of the work.

QUICK-REFERENCE JOB-CARD HOLDERS

There is no fumbling through a file drawer for active job records in the office of V. A. Pinkerton, shop superintendent of the Fred W. Kiemle Company, motor repair division, at Toledo, Ohio. When Mr. Pinkerton gets an outside call checking up on the status of a repair job, he wants to be able to answer the customer with a minimum of delay. So he developed simple, inexpensive card holders to do the trick.



This motor's in the "doghouse" so YOU can stay out!

Even under normal conditions, many motors must be placed close to walls or surrounded with equipment which reduces the free flow of air. With today's motor-relocation problems facing so many manufacturers, the chances of motor overheating are often multiplied.

To help you beat the heat on motors that must be mounted in close quarters, R & M engineers put all newly designed Uni-Shell Motors through the "doghouse" test. Here, the air flow produced by the fans within these motors is directed through the cone-shaped box and measured. How well the fan controls temperature rise depends on fan design, location, and the shape of motor housing openings through which the air must pass.

To evaluate these factors, to build up a background of fan efficiency, to make certain that you can't go wrong with Uni-Shell Motors for operation in high-temperature or poorly ventilated areas, is the purpose of the "doghouse" test.

If you have a motor problem (be it one of overheating or any other) let R & M engineers help you solve it.

FREE NEW BOOKLETS!

"SHADED POLE MOTORS," Form No. 1887. "MATCHED MOTOR PARTS," Form No. 1871. "UNI-SHELL INTEGRAL H.P. MOTORS," Form No. 1845. "MOTOR GENERATOR SETS," Form No. 1881.

Send for any or all of these booklets, now.

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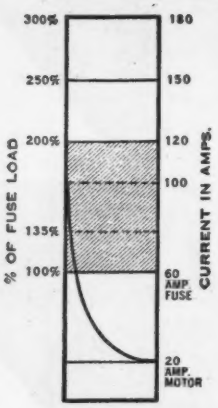
In Canada: Robbins & Myers Co., of Canada, Ltd., Brantford, Ont.
MOTORS · HOISTS · CRANES · MACHINE DRIVES · FANS · MOYNO PUMPS · FOUNDED 1878

LAG...

THAT KNOWS WHERE IT BELONGS-DOESN'T HARBOR SHORTS OR GROUNDS



Pierce "Balanced Lag" link design locates plenty of lag in area reached by currents "at work," but leaves only a necessary amount in the higher trouble zones.

OVERLOAD RANGE

Momentary "squirrel cage" starting currents (up to 6 times running current) fall within the "overload range" (shaded area).

The new Pierce "Balanced Lag" link locked in place in the inner tubular-arched unit of the Pierce Fuse.

WHERE LAG BELONGS

Lag, to keep serviceable machines running, should be plentiful in the "overload range," where the working currents flow. The new Pierce link, for example, has 3 to 5 times the lag, at 135% fuse load, of any other lag-links tested, with similar balance thruout the "overload range."

SOLD THROUGH LEADING DISTRIBUTORS

PIERCE BALANCED Lag RENEWABLE FUSES

MADE BY PIERCE RENEWABLE FUSES, INC., BUFFALO 7, N. Y.

Each card holder is made of a 17½-inch piece of 1½ in. by 3¼ in. wood block with 15 slots cut into it at approximately a 45 degree angle and about one-inch spacing. The upper portion of each card placed in the slots —due to the spacing and angle—is clearly visible and shows the name of the customer, order number and job number. With the blocks propped up on the desk at a 45 degree angle, the cards are in a vertical position and specific ones can be spotted at a glance and quickly removed for reference.

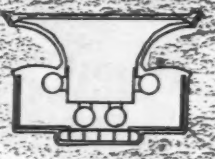
As each job is completed and shipped, the job card is removed and placed in the standard file folder with other relevant data (order, etc.). As the number of active jobs increase, additional card holders can be used. Spare holders can be neatly stacked alongside the desk.

Wood block card holders provide a quick reference file of active jobs in the motor repair shop of the Fred W. Kiemle Co., Toledo, Ohio. The spacing and 45 degree angle of card slots cut in the blocks make upper portion of each job card visible at all times. Specific card selection requires only a quick glance.

The card holders are placed at the right hand side of Mr. Pinkerton's desk. When a job-status call comes in, he quickly spots the job card in question and gives the answer. If additional information is required, he merely picks up the shop phone (at right of desk) or uses the shop intercom system to secure the information in a few seconds. It all adds up to greater shop efficiency and better customer service.

It is customer service of this type which increases Kiemle Company orders. Prompt handling of customer inquiries establishes confidence in the firm and increases Company good will.

FOR FOUR 40-WATT FLUORESCENT LAMPS



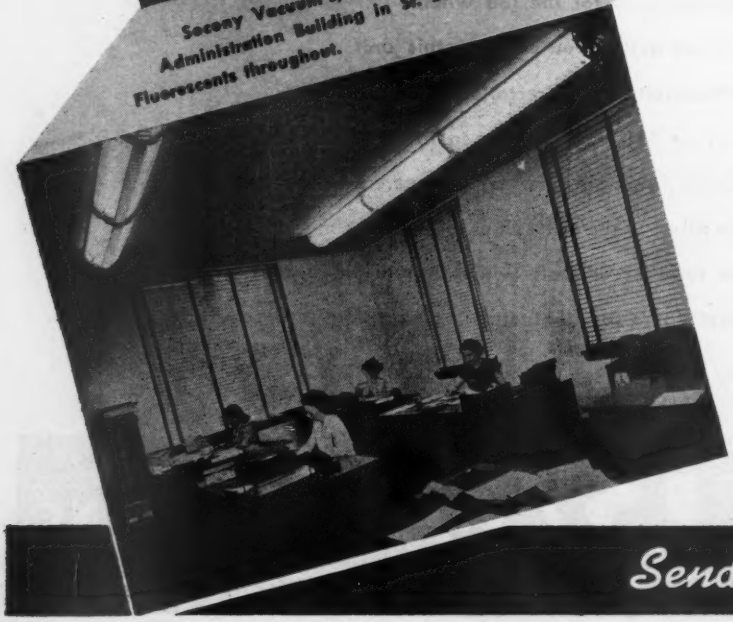
Originally a special design for the customer who could afford to pay for exclusiveness and to wait while the artist's drawing was executed in steel and glass, the 70610 XE has proved so attractive and popular that it is now regularly stocked at the factory • Custom-built for the job where the ordinary commercial luminaire is not quite good enough, this unit finds its proper surroundings in the dignity of a director's room, a private office, an exclusive shop. . . . • This unit is easy to install and maintain, and, like all Curtis luminaires, it is engineered to do a real lighting job • The price, while not suited to the mass market, is reasonable for the type of job on which it will be used • Available as individual four-foot luminaires or in continuous rows as illustrated.

CURTIS Lighting, INC.
6135 WEST 65TH STREET, CHICAGO 38, ILLINOIS

GET LIGHT WHEN SPECIFYING FIXTURES...

For 2 or 4 20-watt lamps, and 2, 4 or 8 40-watt lamps in both 4 and 8-ft. lengths. 8-ft. fixture has single piece body. Graceful, versatile, of highest efficiency. Incorporates all Joleco's currently released exclusive features. For ceiling or suspension mounting.

Sacony Vacuum's, Lubrite Division, ultra-modern Administration Building in St. Louis uses Joleco Fluorescents throughout.



SMART and modern beauty is only one additional advantage gained in this Joleco installation of J-45's. ***Specifically*** engineered for an above-average 55 footcandles of ***maintained*** high intensity lighting, Joleco's J-45 is providing the soft, non-glare, flickerless, trouble-free illumination that assures accuracy of detail and greater smooth-flowing efficiency.

It is simply good business to investigate Joleco Fluorescents before specifying fixtures. Unusual flexibility in design adaptable to most architectural motifs or lighting installations, and with definite cost and maintenance advantages, Joleco Fluorescents, incorporating significant developments in illumination engineering, can help you whip *your* lighting problems ***now!***

Send for complete information

JOLECO FLUORESCENTS CAN WHIP *YOUR* LIGHTING PROBLEMS!

More light . . . faster installation . . . lower maintenance . . . are the result of these significant exclusive developments by Joleco engineers:

- ☆ *On-the-point lamp positioning doubles reflecting surfaces and greatly increases lighting intensity.*
- ☆ *Ventilation method based on principle of air-draft cooling prolongs ballast life, reduces cost.*
- ☆ *One-piece strongly reinforced body to prevent twisting and buckling means easy one-man installation.*
- ☆ *Instantly removable inspection plate provides complete access to fixture body, saves time and labor.*

The unusual value provided by Joleco Fluorescents in increased lighting efficiency, trouble-free performance, fast and easy installation, and simplified maintenance offer contractors and lighting engineers many definite advantages for fulfilling the most exacting specifications wherever the finest illumination is desired.

Other Joleco Fluorescents *NOW BEING PRODUCED*

J-65 COMMERCIAL

For 2 or 4 40-watt lamps. Specially designed aligners and coupling plates make the J-65 adaptable for continuous runs of any length. Gives appearance of single fixture. Same Joleco exclusive advantages as J-45.

J-67 COMMERCIAL

Open type fixture for 2, 3 or 4 40-watt lamps. Maximum light utilization with minimum cost. Bodies of sparkling white baked enamel. End plates have satin finish. Same exclusive Joleco features as J-45 and J-65.

J-66 INDUSTRIAL

For 2 or 3 40-watt or 100-watt lamps. Suspension or ceiling mounting. High intensity, glareless light. Starters accessible from outside. For continuous runs, square cut ends butt snugly together without light leakage. Special couplings add strength and rigidity.

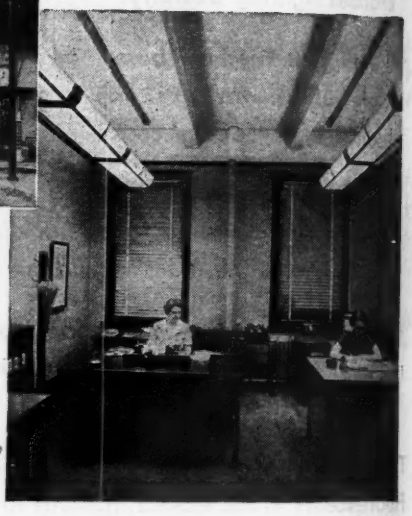
JOLECO
CORPORATION
Designers and Manufacturers
FLUORESCENT LIGHTING FIXTURES
2513-19 BALDWIN ST. ST. LOUIS 6, MO.

. . . and catalog pages ⇨

2-Way Help

on your lighting jobs...

OUTDOORS
industrial yards, buildings, play areas, airports, etc.



INDOORS
Plants, institutions, offices, stores, residences

Here's why it's wise to have Graybar work with you on all your lighting jobs: (1) Whatever your customers' requirements, Graybar can impartially recommend the exact lighting equipment for their particular needs from the most complete selection of lamps and lighting units available from any one source. (2) In many cases, delivery from a local Graybar warehouse saves time.

A Graybar Lighting Specialist will help you solve your customers' lighting problems most efficiently, attractively, and economically. Call the Graybar office nearest you. Or write to *Graybar Electric Company, Graybar Building, New York 17, N. Y.*

4586

ADEQUATE WIRING — THE KEY TO THE HOME OF TOMORROW — SERVES AND SAVES

Via Graybar
— serving the Nation's Electrical Contractors

IN OVER 80 PRINCIPAL CITIES

Answered by
F. N. M. SQUIRES and GLENN ROWELL
Chief Inspector
New York Board of Fire Underwriters
New York, N. Y.
Electrical Engineer
Fire Underwriters Inspection Bureau
Minneapolis, Minn.

QUESTIONS ON THE CODE

MOTOR SWITCH

Q. *"A pump is installed in a pit at some distance from the barn wherein the motor switch is located.*

"The motor circuit is provided with a double throw switch to throw from manual to automatic starting. The motor is two wire 220 volt, 1 hp.

"Can a single throw single pole switch be cut in ahead of the above double throw switch and the circuit for it run out to the pit so that this single pole switch may be located within sight of the motor and thus comply with the Code requirement?" —E.S.

A. No. The switch, which is used to disconnect the motor so as to be able to work on the motor and thus has to be within sight of the motor, must disconnect all ungrounded wires to the motor.

The simpler way is to have the motor disconnect switch capable of being locked in the open position or in a box which can be locked as permitted in Rule 4409.—F.N.M.S.

INDUSTRIAL REWIRING

Q. *"A former war plant is being converted to an entirely different type of production in our town and I have the rewiring job. Several of the new machines being installed are powered by more than a single motor, and in some cases the operation is such that not all of the motors can operate at the same time on individual machines. In figuring the size of the feeders to each machine, must I use 125 percent of the full load running current of the largest motor plus the combined ratings of the additional motors, or may I just figure the motors that can operate at the same time?"*—L.W.

A. On many multi-motor powered machines the operations performed are such that it is impossible to operate all motors at the same time. Whenever this condition is encountered, Section 4316 of the N. E. Code permits deviation from the general rule of assuming 125 percent of the full load running current of the largest motor plus the sum of the full load current of the other motors, but it does require that the authority enforcing the Code grant permission to consider only the greatest possible load in determining the size of the feeders.—G.R.

FIXTURES IN HAZARDOUS LOCATIONS

Q. *Why is it not possible to use a "vaportight" fixture in a room subject to gasoline fumes? If it is really a vaportight fixture, it certainly should be suitable.—A.E.K.*

A. If a "vaportight" fixture were vaportight it probably would be suitable, but they are not vaportight and therefore are not safe to use in an explosive atmosphere. This type was originally designed as a vaporproof device for use where subject to corrosive atmosphere. I do not know why its name was not changed to corrosion-proof when explosion-proof equipment was first introduced. Prior to the introduction of explosion-proof fixtures, we had nothing better and consequently it became common practice to use the so-called "vapor-proof" fixtures within an explosive atmosphere as it was somewhat safer than the ordinary open type.—G.R.

SERVICE ENTRANCE CABLE

Q. *"We would like to have information on the use of service cable type SE style U as there is very little information in the 1940 Code."* —A.K.

A. Type SE, Style U cable is a service entrance cable which may be used as a combination service drop and service entrance cable in a continuous length from the pole to the house and down the house and into the service equipment provided that where it runs down the house it is not subject to mechanical injury. That is, it could not be used on the driveway or sidewalk side of the house.

The "Style U" designation means that it does not have the steel strip wound over the neutral conductors. Some lighting companies, which require the "tamper-proof" type of cable do not approve of it.

It cannot be used underground.—F.N.M.S.

OIL BURNER INSTALLATION

Q. *"Should any material other than thin wall or rigid conduit be used on the installation of oil burner equipment using 110 volts with the exceptions of flexible joints between fittings and motor and stack controls. Also is it necessary to run individual conduit to each, such as stack, pressure control and low-water control? Can BX cable be used? Also, what about grounding oil tanks?"*—N.K.M.

A. There is no reason why any recognized wiring method cannot be employed in running the 110 volt wiring to an oil burner equipment. The Code does not prohibit the use of other than rigid conduit or electric metallic tubing. If the wiring method employed is subject to mechanical injury, excessive heat or moisture, of course proper precautions must be taken. The wiring method to be employed on the control circuits is governed by the source of current used on those circuits. If it is the 110 volt house current, then the control wiring must comply to all Code requirements. If however, the current for the controls is derived from a bell ringing type of transformer or one complying with the limitations of Class 2 Systems as described in Section 8003, the wiring for control circuits other than safety control circuits may be installed in accordance with Sections 8011 to 8031.

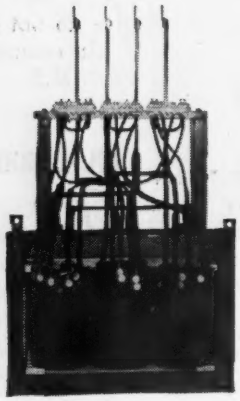
In all cases safety control circuits,

DAVIS TRANSFORMERS

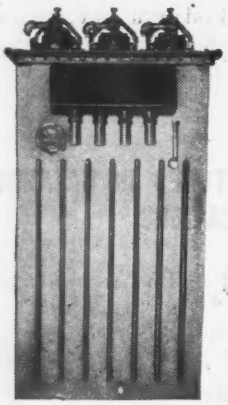
A Davis Transformer for Every Purpose

Primary side with gang operated oil fused cut-outs also cablehead for conduit lead covered cable.

Subway-Type



75 K.V.A., 60 Cycle, Three Phase, 4160—208Y/120.



Secondary side with four wiping sleeves for 500,000 CM lead covered cable and other NEMA and AIEE standard accessories.

Davis Transformer Company offers a complete line of power and distribution transformers both oil cooled and dry type. This has been our regular line for years consequently we are in production and ready to offer excellent service immediately without the usual reconversion problems.

DAVIS TRANSFORMER COMPANY

DAVIS TRANSFORMER CO.
Phone 177 CONCORD, N. H.

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STOCKWELL TRANSFORMER CORP.
CONCORD, N. H.—Phone 177 AKRON, OHIO—Phone Jefferson 4179

Manufacturers of Oil Cooled, Dry Type, Power and Distribution Transformers
Also All Types of Specialty Transformers Regardless of Size

such as stack temperature control, pressure control, low water control, hot water cutoff, etc., must comply with Article 300. Of course metallic covering is desirable. See 8006, a2.

Armored cable can be used.

The oil tank is not electrical equipment so is not covered by the Code. Its grounding is desirable.—F.N.M.S.

RURAL STORE WIRING

Q. *"I am wiring a country store building being serviced by an REA high line. The first floor of this building has a metal ceiling and rather than go to the expense of removing part of it the owner has requested that the wiring be run exposed to the ceiling outlets on this floor. I used ordinary outlet boxes and non-metallic sheathed cable painted the same color as the ceiling, and now I am advised by the inspector that the boxes will have to be insulated from the ceiling. Is this really necessary and if so, how can it best be accomplished?"*—J.B.

A. Probably your best bet would be to substitute non-metallic boxes for the ones now in place. In fact if you are depending on a driven rod for a neutral ground the N. E. Code under Section 3716 forbids the use of metal boxes on a non-metallic sheathed cable installation unless the neutral ground is made to a continuous underground metallic water piping system. If the neutral is grounded to an underground water distribution system, the metal boxes must either be insulated from the metal ceiling or individually grounded as required by Section 3701 of the Code, which reads as follows: "Metallic outlet boxes used with knob and tube work or non-metallic sheathed cable, and mounted on metal or metal lath ceilings or walls, shall be insulated from their supports and from the metal or metal lath, or shall be grounded." If the neutral ground for this building is made to an underground water piping system, you may either insulate or ground these boxes; however, the use of non-metallic boxes would be the easiest way of meeting Code requirements.—C.R.

TYPE SN WIRE

Q. *"Does the Code permit the use of type SN wire for knob and tube work? I cannot find such permission in my copy."*—L.C.M.

A. The 1940 edition of the N. E. Code did not permit the use of

THE MESSAGES GO THROUGH

NORTH, EAST, SOUTH, AND WEST—binding America into a compact unit—is the vast wire network of Western Union. The swift, sure service of that great organization entails a constant battle with the elements, and special safeguards at danger points. Where wires run through trees, for instance, VINYLITE plastic insulation—lightweight, non-aging, and non-flammable—protects their electrical efficiency. A braid covering helps absorb the wear of swaying branches.

For "tree wire", as for many applications outdoors and in, Western Union has found VINYLITE plastic insulation superior to older types. Its dielectric strength permits thin-wall construction. Besides its non-aging and non-flammable qualities, it is highly resistant to moisture, abrasion, most acids, alkalies, alcohols, and solvents. It stays flexible at low temperatures. And VINYLITE plastic insulation can be made in a full color range for easy identification—opaque, transparent or crystal clear.

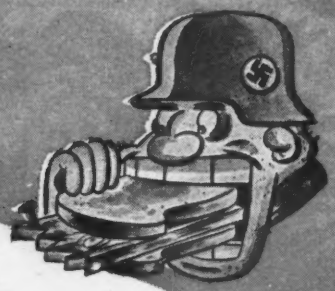
Specify VINYLITE plastic insulation for new standards of life and performance in your own wiring applications. Write Department 41 for your copy of "VINYLITE Plastics for Wire and Cable Insulation". It describes the varied possible types that make this material superior for widely diversified service conditions.

BAKELITE CORPORATION
Unit of
Union Carbide and Carbon Corporation
UCC
30 EAST 42ND ST., NEW YORK 17, N.Y.

Vinylite Plastics

TRADE-MARK

THE NAZIS HAD A WORD FOR IT

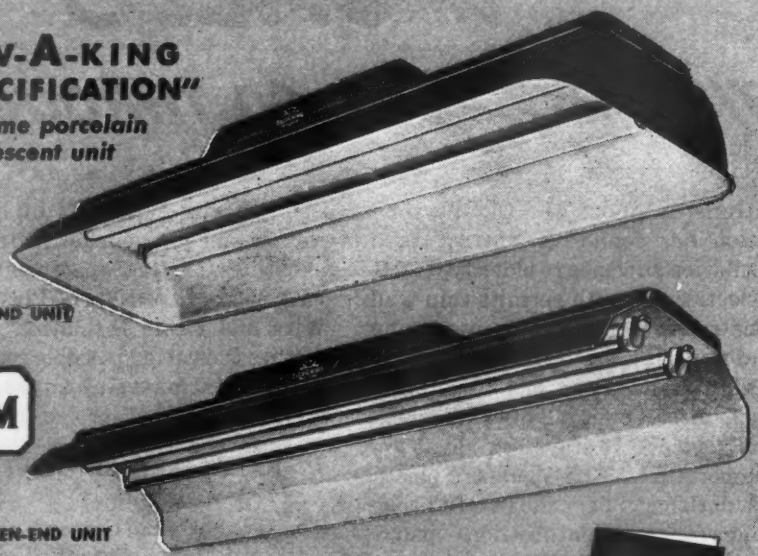


Ersatz!

Not so long ago, lighting fixtures were made of various substitutes, held together with scarcely more than a prayer.

Some lighting products, we're told, are still made that way. But not SILV-A-KING products! Ever since Uncle Sam gave us the nod, nothing but the best of pre-war (and post-war!) materials and engineering have gone into SILV-A-KING fixtures. That's why today's SILV-A-KING fluorescent fixtures are drawn one-piece and seamless of heavy gauge steel, have a porcelain-enamel finish that will maintain initial reflectivity and last for a lifetime. That's why SILV-A-KING fixtures embody a host of important construction features that make for better performance . . . improved appearance.

SILV-A-KING "SPECIFICATION"
Lifetime porcelain fluorescent unit

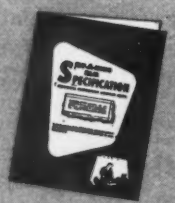


CLOSED-END UNIT

RLM

OPEN-END UNIT

Nothing "ersatz" about this bulletin! It's No. 45FS, fully describing the "Specification" model in both open and closed types.



SILV-A-KING LIGHTING EQUIPMENT

BRIGHT LIGHT REFLECTOR CO. INC.
Metropolitan & Morgan Aves., Bklyn. 6, N. Y.

type SN conductors for knob and tube work; however, the Code was amended on May 7, 1942 and again on February 10, 1943 to permit the use of type SN conductors wherever types R, RP and RH rubber insulated conductors are acceptable. This permission may be found in interim amendment No. 46, and will undoubtedly be found in the next edition of the Code. The designation for this thermoplastic insulation has been changed and is now known as type T.—G.R.

WIRING A HAY MOW

Q. *"An Inspector said that Romex was acceptable in a hay mow. Is this correct?"*—N.K.M.

A. Hay might be classified as combustible fibre and it is certainly easily ignitible. Thus a hay mow might be classified as a Class IV location.

At certain times considerable hay dust is thrown into the air in hay barns and sometimes some grain dust may also be present, and also this dust collects on everything in the barn including the farmer. Hence the barn might be placed in a Class II classification. Notwithstanding all the above, the National Electrical Code does not mention barns or hay mows, so evidently it was not the intent of the Code to place these occupancies in the hazardous class.

Unless the inspection bureau having jurisdiction does rule that these places come within the scope of the rules for hazardous locations, then non-metallic sheathed cable could be used if installed in accordance with Article 336.—F.N.M.S.

PROTECTING NON-METALLIC SHEATHED CABLE

Q. *"When a non-metallic sheathed cable is run through a floor and protected with pipe nipple, does the Code require that the nipple be filled with a compound? One inspector keeps insisting that I do this whenever I do any work in his territory, but I can find nothing in the Code regarding this."*—S.M.

A. The N. E. Code does not require the pipe nipple protecting non-metallic sheathed cable to be filled with a compound, but in frame buildings where hay chaff is present it is an excellent practice especially in the colder climates. Hay chaff and other dusts common to the dairy industry find their way into these nipples, and during the winter months this ac-

PREFERRED SAFEGUARDS FOR FLUORESCENT LAMPS

GE

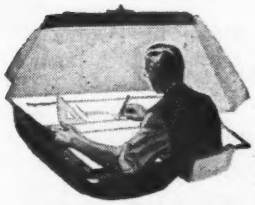
Watch Dog
REG. U.S. PAT. OFF.

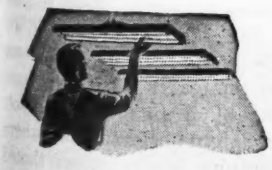
STARTERS

HERE'S ONLY A FEW OF THE IMPORTANT REASONS WHY THESE THREE PREFER G.E.

1. *Users* in stores, offices and factories prefer Watch Dogs because they eliminate annoying blink once and for all. Once the Watch Dog starter cuts out, blinking cannot possibly recur.

2. *Lighting Engineers* specify Watch Dogs because their precise construction provides unusually long life. The Watch Dog outlasts five ordinary starters.



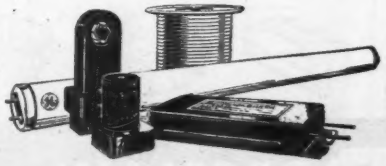


3. *Maintenance Men* consider Watch Dogs as faithful helpers because these starters reduce lighting maintenance to the simple job of pushing a button before relamping. Simply reset it . . . forget it.

G-E Watch Dog Starters have been providing efficient and economical service for 30-, 40-, and 100-watt lamps in commercial and industrial lighting fixtures for several years. These manual reset starters have saved many manhours of maintenance. They've completely eliminated annoying blink of dying lamps. They have extended the life of fluorescent lamps with precision starting and positive stopping. Users of fluorescent lighting, engineers and maintenance men all over the nation are switching to G-E Watch Dog Starters, the preferred safeguards for fluorescent lighting.

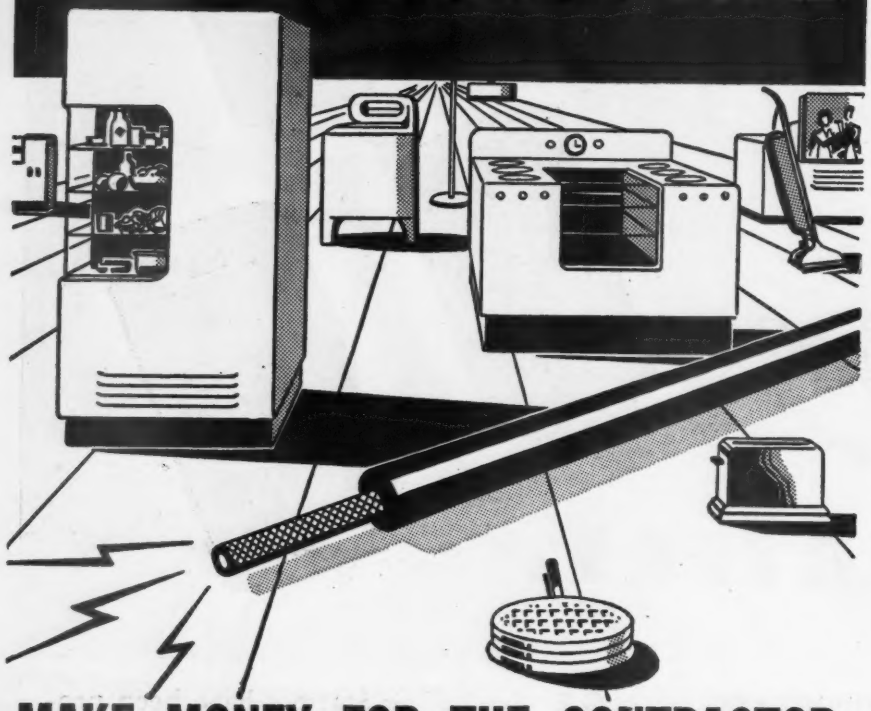
Get the complete story about G-E Watch Dogs by writing to Section G1053-8, Appliance and Merchandise Dept., General Electric Co., Bridgeport, Conn.

LAMPHOLDERS
STARTERS
BALLASTS
LAMPS
WIRE



GENERAL GE ELECTRIC

PORCELAIN CARRIES A BIGGER LOAD



MAKE MONEY FOR THE CONTRACTOR
SAVE MONEY FOR THE CONSUMER!

To avoid costly under wiring—install adequate capacity with PORCELAIN Protected Wiring! This system carries a 33% to more than 100% greater load than any other wiring method—wire size for wire size. Thus, the modern Porcelain way—with its extra capacity—eliminates the chance of overloaded circuits and assures the home owner that he is actually consuming all the current he pays for, while at the same time you make a more economical installation.

Wire for tomorrow's load with PORCELAIN—the non-metallic way, time-proven for safe, durable, economical wiring. Ask your Electrical Inspector about knob-and-tube wiring for safety. Write for wiring manual.

PORCELAIN PRODUCTS, Inc.
FINDLAY, OHIO

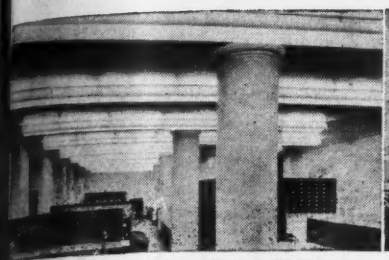
Wire Today for Tomorrow's Load

cumulation will absorb a considerable amount of moisture causing a gradual deterioration of the insulation. Many instances have been found in northern states and Canada where the outer sheath has rotted away in several years time within confined spaces such as the pipe nipple would afford. It would therefore seem most practicable to follow the suggestion of this inspector and fill these nipples with compound or oakum.—G.R.

LIGHTING PAINT SPRAY BOOTHS

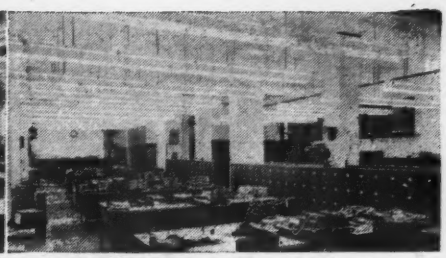
Q. *"We are now rewiring a small manufacturing plant and part of this job will include the lighting of several small paint spray booths. I understand that the Code will not permit the installation of lighting fixtures within the booth even though they might be of the explosion-proof type. The management wants excellent light within these booths and refuses to accept an installation consisting of vapor-tight floodlights mounted outside the open face of the booth. How can I comply with the Code and still furnish ample illumination?"*—S.C.

A. A paint spray booth may best be lighted by light from ordinary reflecting type fixtures directed through one-quarter inch thick wire glass panels inserted in the ceiling or side walls near the ceiling or both. These wire glass panels should be held in place with angle iron frames so constructed that the inside of the booth will be as smooth as possible. By coating the inside surface of the wire glass with a special transparent coating made for such use or even with an ordinary light grease, any excessive accumulation of paint spray residue may be easily removed. Continued use of this coating will make it possible to maintain adequate illumination. If spray painting operations are conducted outside the booth or if the flow of air through the open end of the booth is not sufficient to prevent the flow of solvent vapors or paint spray residue back into the room, this method of lighting the booth interior would not be safe and the entire room or at least all portions of it in which the solvent vapors might accumulate or where the paint residue might gather should be considered hazardous. No electrical fixture or motor of any type should be located where the paint spray residue may lodge upon it, as an accumulation of this residue will prevent such devices from dissipating the heat they are designed to radiate.—G.R.



Minneapolis, Minn. Sixty-eight Foot-Candles are provided using 2.3 watts/sq. ft. FUTURLITERS are arranged continuously with rows spaced 8'0" apart. Ceiling-height is 11'0". Installation was engineered by Mr. H. F. Strehlow of the Guth Co.

Warren, O. This prize-winning installation of FUTURLITERS provides 75 F.C. and uses 2.15 watts/sq. ft. Ceiling-height is 10'0", and rows are on 6'0" centers. Engineered by Mr. W. C. Schultz, Ohio Public Service Co.



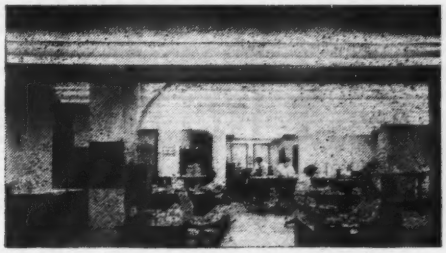
Chicago, Ill. Illumination at desk-level is 60 F.C. with 2.5 watts/sq. ft. FUTURLITERS are suspended from the 13'6" ceiling to a 9'6" mounting, and rows are on 7'0" spacings. Note the generous ceiling illumination. Engineered by Mr. G. A. Hall of the Guth Co.

WIDESPREAD ACCEPTANCE

Guth FUTURLITER T. M. REG.

INSTALLATIONS tell the whole story of this Famous Fixture

Houston, Tex. Using 2.9 watts/sq. ft., FUTURLITERS provide 54 F.C. The "45° Positioning" of drafting tables effectively reduces shadows. Ceiling-height is 10'9", and fixture rows are 8'4" apart. Engineered by Mr. H. G. Hrivnatz of the Houston Lighting and Power Co.



St. Petersburg, Fla. Cool fluorescent lighting for warm, beautiful St. Petersburg! There are 75 Foot-Candles on Drafting Tables, and 50 Foot-Candles in office areas, after 1,000 hours operation. Engineered by Mr. W. B. Shenk, Florida Power Corporation.

St. Louis, Mo. Fifty Foot-Candles with 3.12 watts/sq. ft. Rows are 8'0" apart. FUTURLITERS are mounted 12" below the 11'0" ceiling. Good lighting provides increased office work, reduces absenteeism and improves employee relations. Engineered by Mr. F. B. Lee, Illum. Eng., General Electric Co.

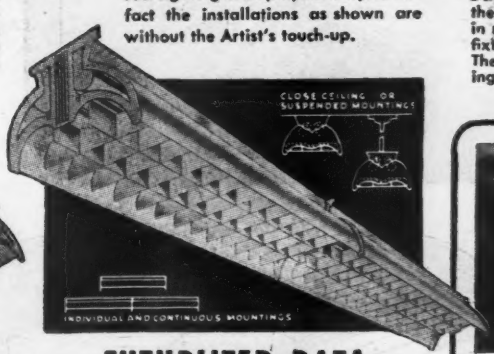
Tulsa, Okla. A prime example of good merchandising illumination (no exposed lamps to distract customers' attention). There are 50 F.C. on the merchandise. Ceiling-height is 14 ft., and spacing between rows is 8'0". Engineered by Mr. A. N. deEspenza of the Lawson Electric Supply Co.

Decatur, Ill. Beautifully lighted stationery and photography store, uses FUTURLITERS in 8'0" sections. Ceiling-height is 12'6", and fixture-sections are on 12'0" x 9'0" centers. Illumination is 33 F.C. using 2 watts/sq. ft. Engineered by Mr. H. E. Chamblin, Illinois-Iowa Power Co.

Dayton, O. Drafting-room with 65 Foot-Candles on the tables is equipped with FUTURLITERS arranged in rows on 8'0" centers. Ceiling is 11'0" high, and fixtures are dropped to a 9'0" mounting-height. There are 3.1 watts/sq. ft. Engineered by the Lighting Dept., of the Dayton Power & Light Co.

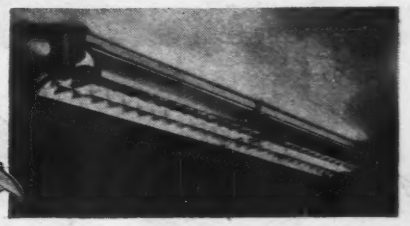
FUTURLITER—the famous Fluorescent fixture—is used in offices, drafting-rooms, banks, schools, stores, and wherever there is need for Direct-Shielded lighting. FUTURLITERS are modern as tomorrow, they are efficient light producers, and are inexpensive to maintain. Investigate FUTURLITER!

NOTE: All photographs used in this advertisement are UNRETOUCHED. Faithful photos are difficult to obtain where shielded-direct lighting is employed. Despite this fact the installations as shown are without the Artist's touch-up.



FUTURLITER DATA

Direct-type luminaire designed to shield lamps at normal seeing angles. All metal, strongly constructed. Finished "300° WHITE". For 2-40 and 3-40 watt F Lamps. Built in 48" sections for individual or continuous-row installations; can be attached directly to ceiling or suspended from same. Available with Conventional or Starterless Ballasts.



"Soft-Light" for Ceilings with the FUTURLITER

To relieve harsh shadows and ceiling contrast, a small amount of light is distributed upward. Whether attached to the ceiling or suspended, FUTURLITER provides a pleasant, cheerfully-lighted room.

THE EDWIN F. GUTH COMPANY
2615 WASHINGTON AVE. • ST. LOUIS 3, MO.
"Leaders in Lighting Since 1902"

Introducing *Our* Line of

FLUORESCENT

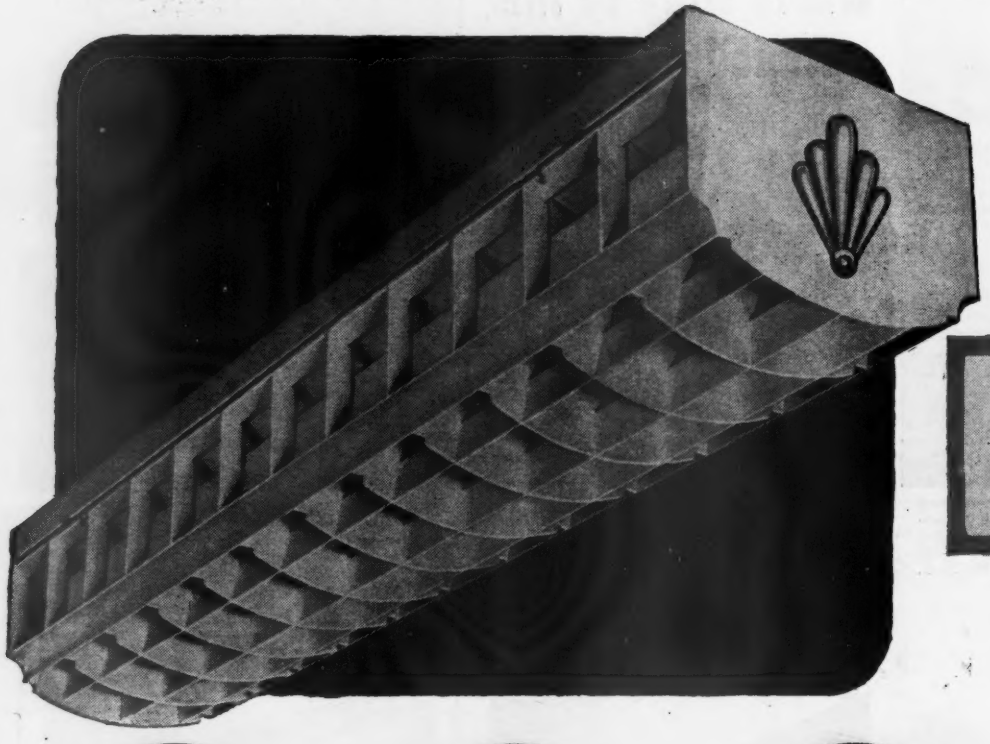
featuring our Series 1420-4-48

PREMIER COMMERCIAL FIXTURE

The Watco Premier is a distinctive, sturdily constructed commercial unit featuring a one-piece hinged louver permitting it to be dropped from either side or can be readily removed for cleaning.

One of the outstanding features of this unit is the fact that no screws are used in the assembly, saving time both for the electrician on installation and the engineer on maintenance.

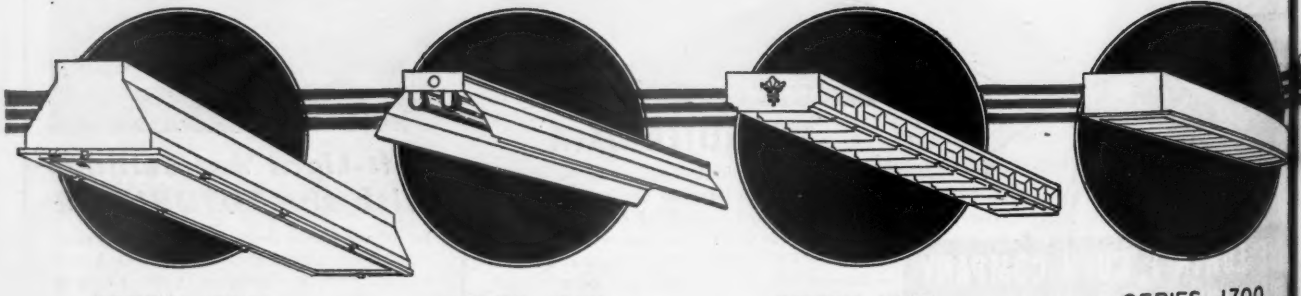
This fixture can be flush mounted to ceiling or suspended. It can be used as an individual unit or joined together for continuous runs. All electrical equipment is ETL approved and carries Underwriter's Laboratory label.



• In addition to the four-lamp unit shown, we also manufacture a similar fixture in two or three lamp 40 watt units.

Send fo

WATCO



SERIES 1200 VAPOR PROOF

SERIES 1300 INDUSTRIAL

SERIES 1400 COMMERCIAL

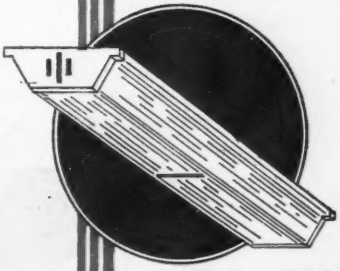
SERIES 1700 RECESSED UNIT

FIXTURES the Ultimate in Modernization!

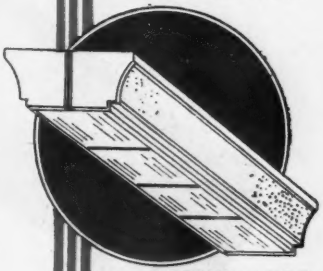
Our Engineering Staff is maintained solely to render service to you. You are invited to send your details or specifications and we shall be glad to submit blueprints showing the most efficient and economical solution to your lighting problems. Inquiries on items of your own design are always welcomed and will be given our prompt attention. The particular inventive genius, ingenuity, skill and ability that makes one product better than another also makes one kind of fluorescent fixture superior to another.

A partial view of first floor installation, Kaufman's Department Store, Pittsburgh, Pa. Sold by General Electric Supply Co., Pittsburgh, Pa.

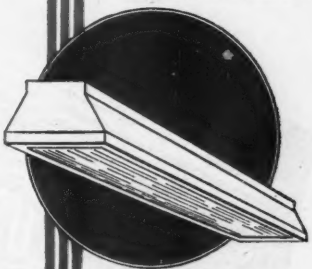
SERIES 1500
DRAFT-O-LAMP



SERIES 2300
COMMERCIAL



SERIES 1900
COMMERCIAL



SERIES 1600
TROFFER UNIT

Complete Catalogs and Details

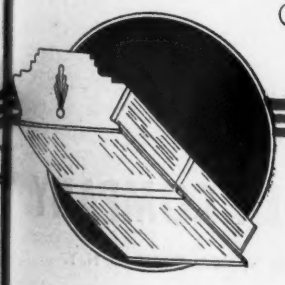
ENGINEERING, INC.

Specialists in Custom Made Lighting

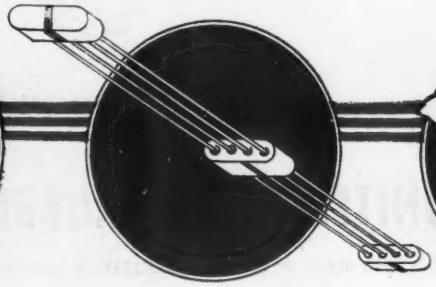
FLUORESCENT DIVISION

CLEVELAND, OHIO, U. S. A.

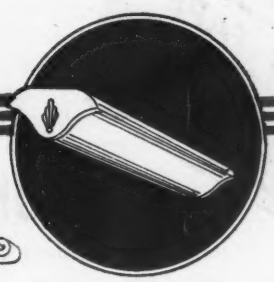
"WINCO" VENTILATING WINDOW DIV. • "TEMPZONE" AIR CONDITIONING DIV.



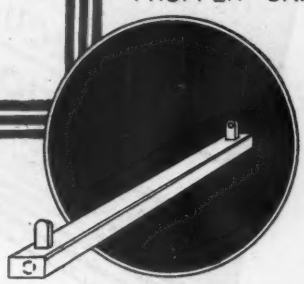
SERIES 2100
COMMERCIAL



SERIES 2600
SLIM LINE



SERIES 2500
KITCHEN UNIT



SERIES 1800
STRIP UNIT

DON'T FLY OFF THE HANDLE—

Safety Tip: **You know how tough it is to hang onto a hammer when the handle gets smooth and slippery. For a firm, sure grip, just wrap a few turns of Security Friction Tape on your hammer. Then notice how much easier it is on your hand—on your temper. You'll find, too, that Security Tape packs a lot of safety on many other jobs.**

Play Safe—Use Security

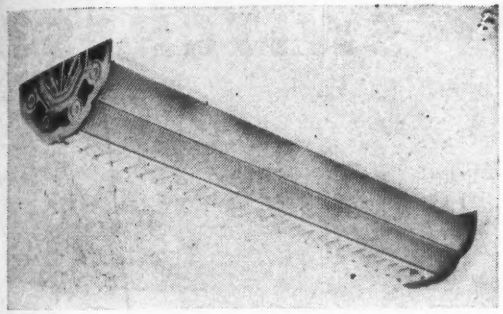
SERVING THROUGH SCIENCE

UNITED STATES RUBBER COMPANY

1230 SIXTH AVENUE • ROCKEFELLER CENTER • NEW YORK 20, N. Y.

THESE ANNOUNCEMENTS of new equipment are necessarily brief—for more detailed description, sizes, prices and other data write to the manufacturers' advertising departments, tell them in what issue of ELECTRICAL CONTRACTING you saw the item and they will send full details to you.

EQUIPMENT NEWS



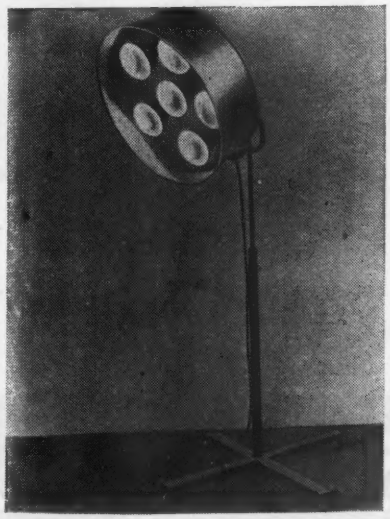
JOLECO FLUORESCENT UNIT

Fluorescent Fixture

A new ventilated fluorescent fixture for commercial use has been announced. It uses either two or four 20 watt lamps, and four or eight forty watt lamps in four or eight foot lengths. It is adaptable for both ceiling or suspension mounting. It has a patented method of positioning lamps on reflector points thus doubling reflector surfaces, utilizing the principle of air-draft cooling for ventilating the fixture body. Joleco Corporation, 2517 Baldwin Avenue, St. Louis 6, Mo.

Portable Infra-Red Unit

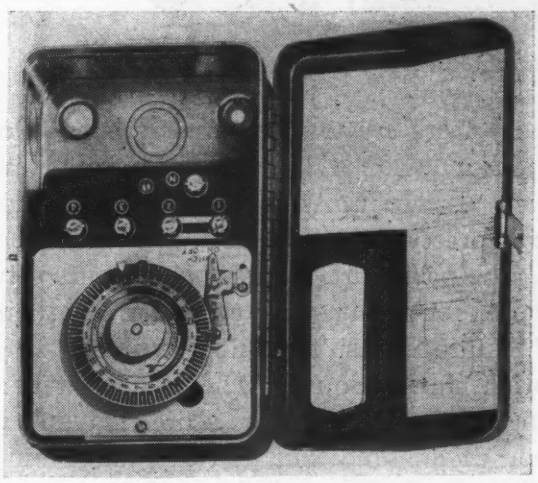
Two new portable infra-red units for use with reflector type R40 or RE40 infra-red lamps have been announced. Model W6 is designed for 6 lamps and R12 for 12 lamps. Reflector type lamps in any size, 125 watt, 250 watt, or 375 watt may be used. They are recommended for use in smaller industrial plants, garages, repair shops, paint shops, etc. They are wired for 105-125 volt service, a-c or d-c. Carbomatic Corporation, 117 West 63d Street, New York 23, N. Y.



CARBOMATIC INFRA-RED UNIT

Time Switch

Latest improvement in the Paragon 300 Series time switches is the Telechron motor—an industrial type, self starting synchronous motor. This series is light in weight, small and compact in design, has switch capacity of 3000 watts per pole with easily mounted accessible terminals, skip-trip feature, knockouts on both sides, back and bottom, and two bearing plate construction. These switches are used for controlling signs, commercial lights, attic fans, stokers, oil burners, blowers, pumps, valves, motors, etc. Paragon Electric Company, 37 West Van Buren Street, Chicago 5, Ill.



PARAGON TIME SWITCH

Signal Relay Connector

CANNON CONNECTOR

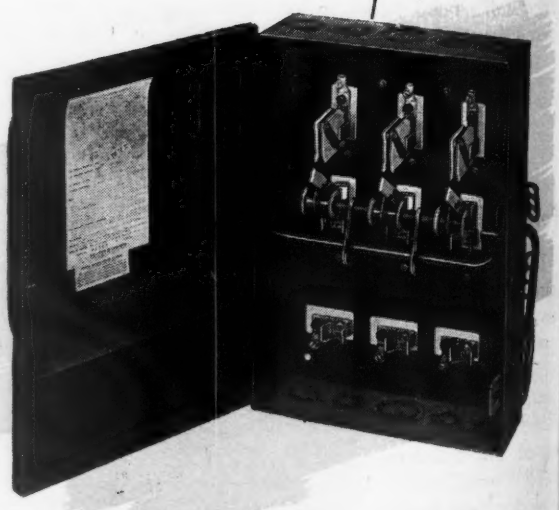
Type RR-1 and RR-2 connector has been specifically designed for the signal field but it is also adaptable to transformers, rectifiers, etc. The connector is made up of a plug and receptacle, having phenolic shells. The receptacle is mounted on the board or back wall of the relay instrument, and contains the pin contacts. The plug portion has socket contacts and is removable. These designs are adaptable to four or six point relays where space allows. Cannon Electric Development Company, 3209 Humboldt St., Los Angeles, Calif.

WHY DO I PICK *Square D* SAFETY SWITCHES?

• Guess there are two or three reasons. Don't know offhand, how I'd rank 'em in importance, but they all add up. For one thing, Square D makes a pretty darn complete line of switches. During the past thirty years I've run into setups that called for about every type and size there is —and Square D hasn't let me down yet.

Another thing—Square D's got a crew of design engineers who know the score. Haven't met 'em, you understand, but you can judge 'em by what they put in their switches and not go wrong.

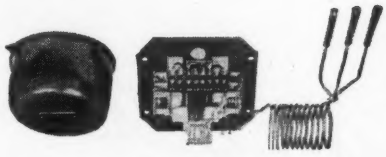
Then again, maybe I'm like a guy I know. Whenever he's in a strange town and doesn't know where to eat, he always looks for the place with the most folks. He figures that's a pretty good steer to good grub. Apply that kind of reasoning to safety switches and you can get only one answer. Maybe you've noticed—you run into that D emblem *everywhere*.



SQUARE D COMPANY

DETROIT • MILWAUKEE • LOS ANGELES

Winding-Temperature Relay

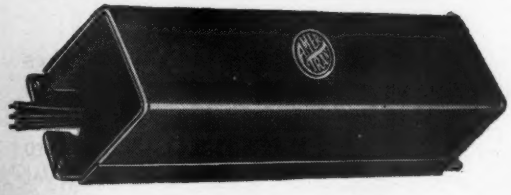


G-E RELAY

A new winding-temperature relay, which permits utilization of the maximum permissible emergency-overload capacity of power transformers under all ambient temperature conditions has been announced. It operates from a combination of top oil temperature, ambient temperature, and load current. The relay has three separate contacts, which close in sequence as the winding temperature increases. On a transformer with cooling fans for supplementary rating, the relay can start cooling fans as soon as the self-cooled, load carrying capacity of the transformer is exceeded; give a warning signal as soon as overload has been on for the permissible length of time; and sound an alarm or trip the circuit breaker. Relay is mounted on the outside of the transformer tank and can be checked in the field without interrupting the load on the transformer. General Electric Co., Schenectady 5, N. Y.

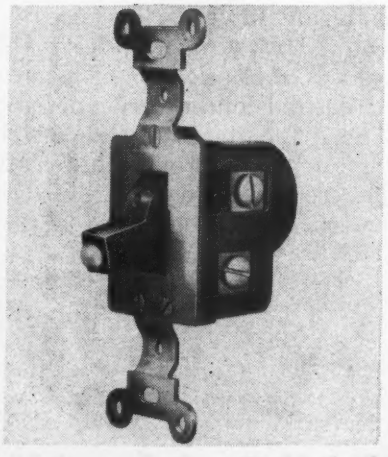
Ballasts

A new line of ballasts for hot and cold cathode fluorescent lighting has been introduced. It is claimed that flicker, end-blacking, premature burn-outs are reduced. Ballasts are suitable for installations where the noise level is low as in churches, homes, lecture halls, offices, etc. It has a roll-turn lead-out that prevents strain on lead insulation and makes wiring easier. Lead-out is of the two-way type and may be attached to exterior or interior channels. American Transformer Company, Newark, N. J.



AMERTRAN BALLAST

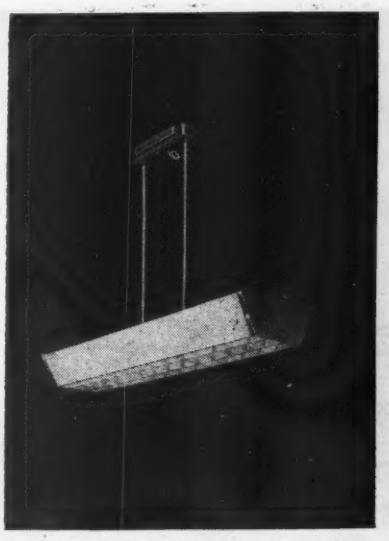
Delay Switch



MUDON DELAY SWITCH

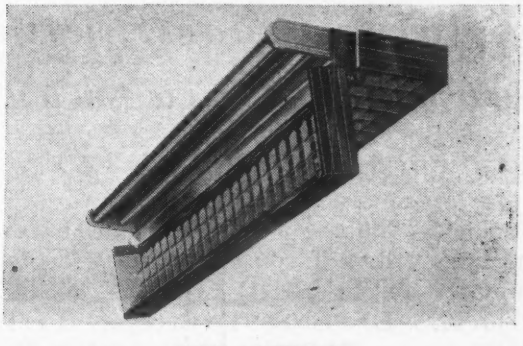
A new all-purpose light or power switch, known as Tymzit, has been announced. It features a unique toggle-lever arrangement which, although operated in the standard manner, offers both delayed-action and instantaneous "off", plus a time-selector for the delayed action which can be set at any interval from zero to three minutes. The toggle lever also features a phosphorescent tip which makes the switch easy to locate in total darkness. Located in the garage, for example, Tymzit will provide more than ample time to walk leisurely into the house before lights actually go off. Bedroom lights will stay on for as many seconds as desired after turning them off at the switch. On the farm, any and all outbuildings can feature lights which, though turned "off" on the spot, will remain lighted while the trip to the house or other buildings is being made. Switch is made to Underwriters Laboratories specifications, and fits any standard wall box. It is available in single and double pole assemblies and rated at 10 amperes at 125 volts and 5 amperes at 250 volts. T. J. Mudon Company, 1240 Merchandise Mart, Chicago 54, Ill.

Fluorescent Unit



PITTSBURGH PERMAFLECTOR UNIT

A new Permaflector fluorescent luminaire No. A-440 and known as "The Wilson" has been announced. This unit features an egg-crate louver bottom which eliminates dust in unit, shields tubes, provides glareless illumination. Louver is hinged so it may be detached for maintenance. It utilizes four 40 watt, T-12 fluorescent lamps operating on a voltage of 110-125, 60 cycle a-c; also available in 50 cycle. The fixture has an overall length of 48⅛ inches, height of 7¾ inches and width of 15⅞ inches. The two side panels are Skytex glass with Satinol finish. Luminaire can be surface or suspension mounted with hanger No. AH-200 individually or in continuous rows. Pittsburgh Reflector Company, Oliver Building, Pittsburgh 22, Pa.



SMITH LOUVERLITE

Lighting Fixture

This lighting fixture is known as the Louverlite and is for use in drafting rooms, schools, offices and institutions. The steel hinged egg-crate louvers, made in two sections, give easy access to the lamps. The wiring runs along a special steel channel. It uses four 40 watt fluorescent lamps. The reflectors direct light downward, but a small indirect component lights the ceiling area. A. L. Smith Iron Company, Chelsea 50, Mass.

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ELECTRO Fluorescent Basic Unit!

NOW...You can make immediate delivery on large orders...without maintaining huge expensive stocks!

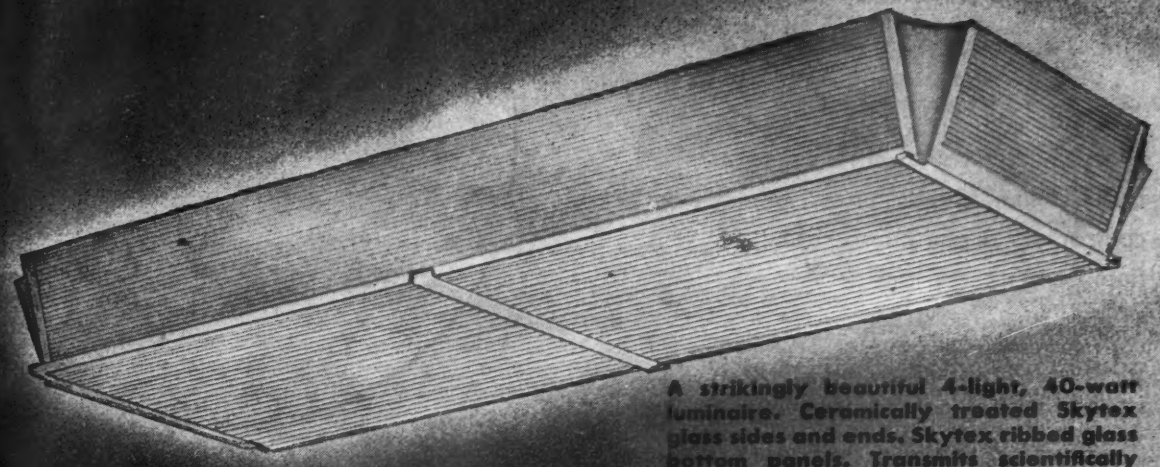
Obviously, you've got a better chance of landing large orders if you can *complete* delivery immediately. THIS NO LONGER NECESSITATES EXPENSIVE BIG INVENTORIES ON *EACH* TYPE OF COMMERCIAL LUMINAIRE. You need stock only one major item—the ELECTRO BASIC UNIT, which you can convert instantly into any type commercial luminaire, with the aid of accessories from packaged sets. Thus, with a much *smaller* total stock, you can fill *larger* orders for any given model.

Moreover, when you sell Electro luminaires you are sure of a satisfied customer. For no other line of fluorescent lighting offers all the features and all the quality you get in Electro . . . engineered for highest levels of lighting, yet with amazingly low surface brightness . . . Starters and lamps instantly removable from the top, and wiring more readily accessible than on any comparable fixture . . . Patented suspension bracket that enables *one man* to install any fixture in less time than is ordinarily required by two men . . . Designs of breathtaking beauty . . . A selection of models affording exact desired concentration of light.

Send for literature showing the spectacular engineering improvements featured in these fluorescents. Sold only by verified electrical wholesale distributors.

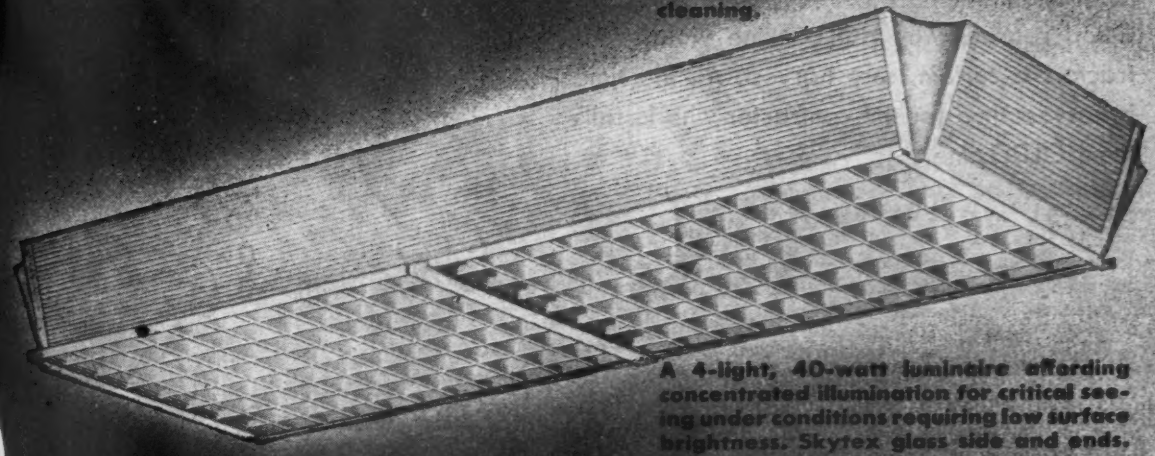
ELECTRO MANUFACTURING CO • CHICAGO

AID EVER OFFERED!..



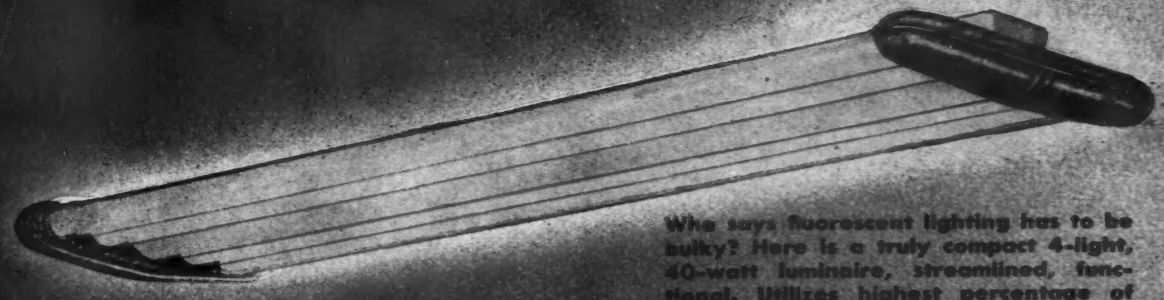
A strikingly beautiful 4-light, 40-watt luminaire. Ceramically treated Skytex glass sides and ends. Skytex ribbed glass bottom panels. Transmits scientifically diffused maximum light, clear and glareless as the daylight in a room with ideal north exposure. Glass easily removed for cleaning.

*ELECTRO U. R. C. LUMINAIRE, NO. 1041



A 4-light, 40-watt luminaire affording concentrated illumination for critical seeing under conditions requiring low surface brightness. Skytex glass side and ends. Steel concentrator panel in bottom contains louvres of size and number determined by extensive laboratory experiment to assure highest efficiency. An unusually handsome luminaire.

*ELECTRO LOUVRE MODEL, NO. 1043



Who says fluorescent lighting has to be bulky? Here is a truly compact 4-light, 40-watt luminaire, streamlined, functional. Utilizes highest percentage of lumen output of the bare lamps. No dark spots on ceiling. Exquisitely designed bakelite ends in rich walnut grain.

ALSO AVAILABLE: No. 1022, two-lite, 40-watt luminaire, same style as 1044.

*ELECTRO'S NO. 1044

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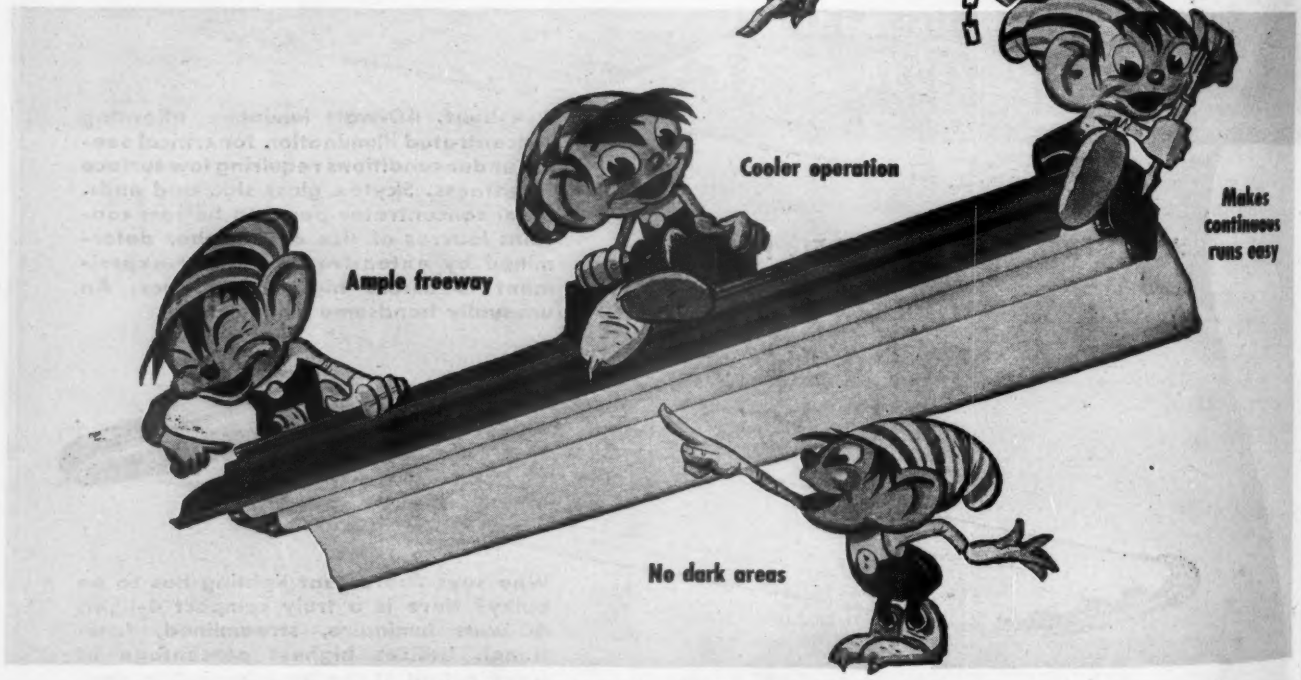
Good reasons why HOLDENline yields contractors a *certain,* sure harvest. All the time is harvest time for the contractor who installs the HOLDENline.



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IN THE NEWS

NECA ANNUAL MEETING
OCTOBER 29-31

The 1945 annual meeting of the National Electrical Contractors Association will be held at the Hotel Carter, Cleveland, Ohio on October 29-31.

The program will cover pressing problems of reconversion, reemployment, distribution, business promotion and public relations of the industry. Round-table seating will be arranged for the luncheons and dinners for delegates.

The NECA Board of Governors will meet in the Hotel Carter, on Sunday, October 28 and Wednesday afternoon, October 31.

L-41 CANCELLED

Government restrictions on the building of homes, public works and commercial structures will be lifted on October 15, as announced by John W. Snyder, Director of War Mobilization and Reconversion.

In telling of the Government's action, Mr. Synder issued a statement, which reads as follows:

"A six-point program to speed expansion of the construction industry was announced today, following an interagency meeting with the Economic Stabilization Director, Will H. Davis, Chairman J. A. Krug of the War Production Board, Price Administrator Chester Bowles and National Housing Administrator, John B. Blandford Jr.

"Simultaneously with this announcement, the War Production Board revealed that Order L-41, restricting home construction, public works and commercial construction, would be withdrawn as of October 15.

"Under the OWMR program, the following steps will be taken:

"1. Through inter-agency action an active campaign to increase the supply of scarce building materials will be undertaken and, if necessary, price and wage increases and priorities to break bottlenecks will be granted.

"2. The War Production Board will strengthen inventory controls to prevent hoarding of building materials so that building will not be delayed by artificially created shortages.

"3. The Office of Price Administration will strengthen price control of building materials to counteract inflationary pressure.

"4. The Federal credit agencies will do everything possible to discourage excessive and unsound lending on mortgages. They will enlist voluntary cooperation of banks and other lending institutions to minimize the danger of inflated prices due to excessive demand.

"5. Representatives of industry groups including real estate, building supplies and construction will be called to Washington to map out a voluntary program to increase quickly the production of all materials and facilities needed for an expanded home-construction industry, and also to help fight inflated building costs and real estate prices.

"6. The National Housing Agency in conjunction with industry representatives will provide an information and advisory service on home values available to any prospective home buyer regardless of whether Federal assistance in financing is involved."

"Can you have your old job back? Are you kidding!"

ATOMIC BOMB PROJECTS WIRED BY FIVE CONTRACTORS

Five electrical contracting concerns, Watson-Flagg Engineering Company, L. K. Comstock and Company, Bryant Electric Company, Lord Electric Company, and Newbery Electric Corporation, all members of the National Electrical Contractors Association, played a major role in the construction of the two huge production facilities that provided the atomic bomb, two of which brought Japan to surrender. According to an announcement by NECA headquarters, all of the major electrical work on the famous Manhattan District Project was done by NECA members.

These companies, their staffs and employees have been commended by the Under Secretary of War who said: "I speak for a grateful nation when I say congratulations and thank you all." Some officials and employees on the staffs of

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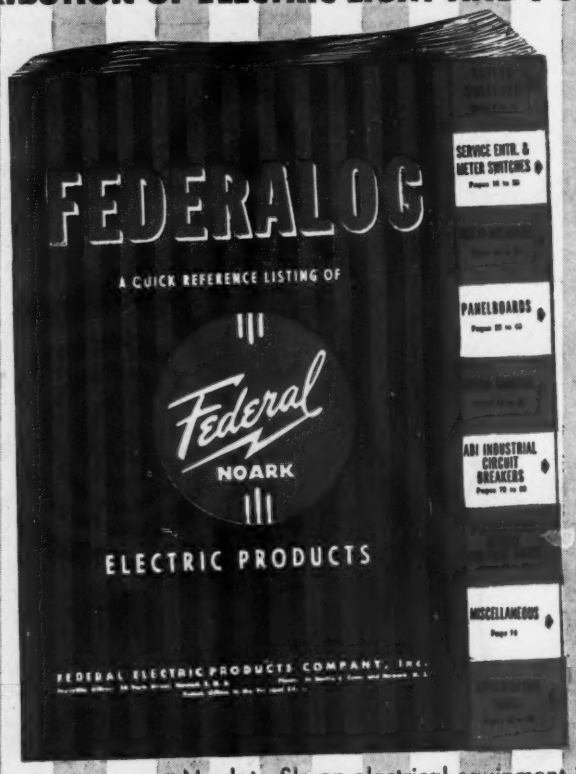

• No data file on electrical equipment is complete without a copy of the FEDERALOG . . . a dependable guide to the newest developments in Motor Controls, Safety Switches, Circuit Breakers, Service Equipment, Panelboards and Multi-Breakers.

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the electrical contracting firms have, from time to time during the work on the projects which encompassed a period of about two years, been singled out for commendation and praise by Army officers on the spot and by the designers and general contractors. Now that the secret of the Manhattan District Project is out, these companies are receiving the congratulations of the industry.

Electrical installations in the plants of the Clinton Engineer Works at Oak Ridge near Knoxville, Tenn., and at the Hanford Engineer Works at Richland, near Pasco, Wash., was considered one of the major subcontracts of the Manhattan District Project. Details of the installations continues to be a closely guarded military secret but it is known that huge quantities of electrical equipment were required for the task. The plants were so compartmentalized that no one worker—only the top scientists and managers knew what was the product or how it was made and for what purpose.

This work was done under the greatest imaginable pressure and under the most trying conditions, particularly those concerning manpower.

The difficulty of obtaining skilled manpower was so great that as late as one year ago the War Department was offering special Certificates of War Service for electrical workers who worked 90 days on the projects.

But thanks to the ability and devotion to duty of all hands, the project was completed and production was started and kept exactly on schedule. The work stands as a monument to the combined efforts of science, industry and labor. Working together they produced in record time the most potent weapon in military history and did it ahead of our enemies.

These are the electrical contractors who shared in the construction of the plants that made the materials for the atom bomb:

At the Hanford Engineer Works, Richland, Washington—

Lord Electric Company, Inc., New York, and

Newbery Electric Corporation, Los Angeles, as co-adventurers.

At the Clinton Engineer Works, Oak Ridge, Tennessee—

Watson-Flagg Engineering Company, New York

Bryant Electric Company, Inc., High Point, N. C. and L, K. Comstock and Company, New York, as co-adventurers.

The job was of such magnitude and the urgency was so great that specialty contractors were asked to pool their organizations and work together as co-adventurers. This was done in the case of the Bryant Electric Company and L. K. Comstock and Company at the Clinton Engineer Works, and in the case of the Lord Electric Company and the Newbery Electric Corporation at the Hanford Engineer Works. In those cases the cooperating companies selected a common project superintendent, and his assistants on the job. Some of the industry's ablest men were given the assignment of directing the electrical construction at this top priority project.

The International Brotherhood of Elec-

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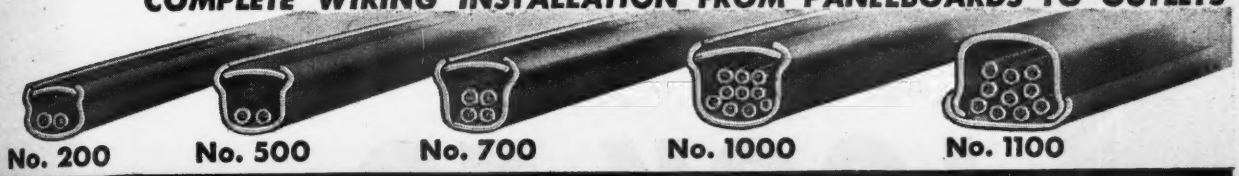
COMPLETE WIRING INSTALLATION FROM PANELBOARDS TO OUTLETS

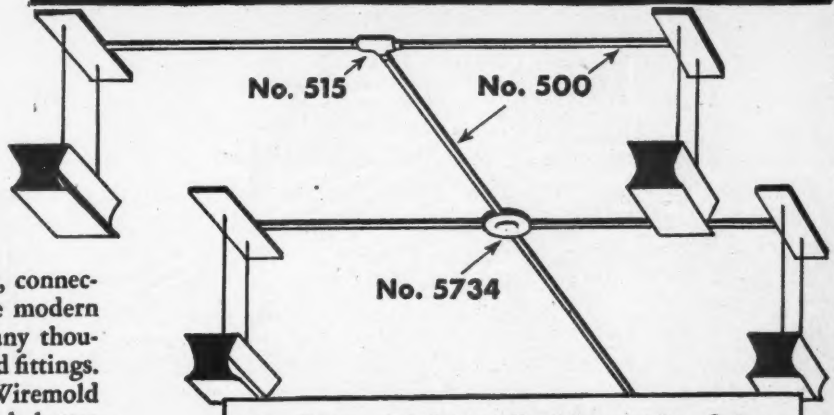


No. 200 No. 500 No. 700 No. 1000 No. 1100

WHERE TO USE THEM . . . .

The Field Branch of the Navy Bureau of Supply & Accounts in Cleveland has been cited by a Congressional Investigation Committee for a "striking demonstration of Government efficiency" Here 3,200 military and civilian workers furnish financial services for some 3,000,000 Navy personnel and nearly 7,000,000 dependents, handling in the neighborhood of $200,000,000 worth of business per month. Naturally, excellent lighting is a vitally important part of this installation and, as the photograph and diagram show, connection between existing wiring and the modern fluorescent units is made through many thousands of feet of Wiremold raceways and fittings. This is a typical example of how Wiremold makes possible better lighting through better wiring in every type of building.

HOW TO USE THEM . . . .



The Wiremold Cutout Tool for cutting fixture canopies to receive Wiremold raceways is now available on loan, and later, when materials are more plentiful, will be manufactured for sale. Write us for details.

THE WIREMOLD COMPANY
Hartford 10, Connecticut

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Fluorescent Circline Table Lamps
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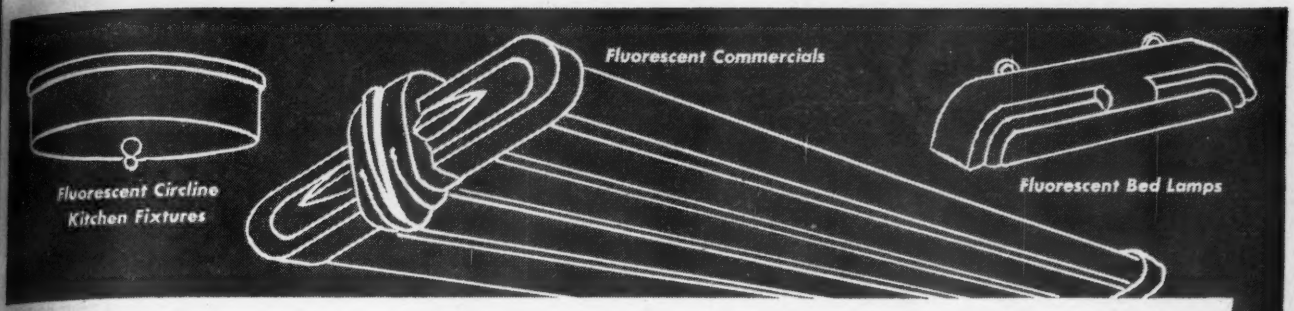

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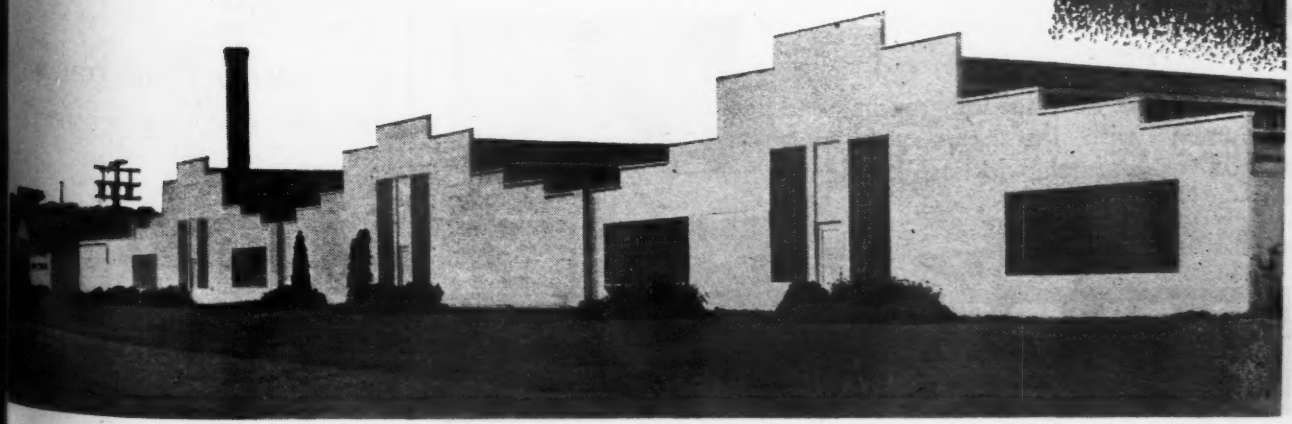

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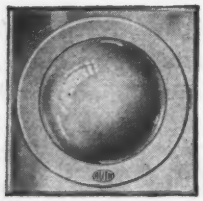
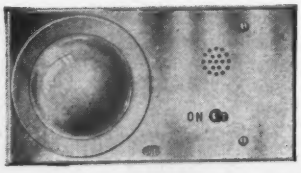
Nurse's Call Station



Corridor Dome Station



Nurse's Duty Station

● Send for Auth Hospital Signaling Bulletin 100. 1-g

AUTH ELECTRICAL SPECIALTY CO., Inc.
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trical Workers' executive officers were responsible for supplying the manpower for the projects. At the Hanford project alone the number of electrical workers employed at one time totaled 2,480 men.

The project was of such critical importanec to the nation that top management of the electrical contracting companies gave unstintingly of their time and talents. Actual work, of course, was delegated to resident managers and job superintendents but few days went by that the top officials were not on the scene.

Following are staff members of the organizations who directed the electrical construction work at the two Manhattan District Projects:

HANFORD ENGINEER WORKS
Lord Electric Company, Inc.,
and
Newbery Electric Corporation

General Direction:
J. M. Hofman, president, Lord Electric Company, Inc.
R. E. Arbogast, executive vice president of Newbery Electric Corporation
(J. E. Chandler was in charge of the job for six months until his death in December, 1943.)

Project Superintendent:
A. L. Wright, Lord Electric Company, Inc.

Assistant Superintendent:
E. F. Watters, Lord Electric Company, Inc.

Superintendents in Charge of Inside Construction:
Chet Galand
Frank Ferguson

Superintendent for Outside Pole System:
Carl Thompson
S. E. Thompson

CLINTON ENGINEER WORKS
Watson-Flagg Engineering Company, Inc.

General Direction:
John L. Flagg, president

Resident Executive Manager:
Vreeland Flagg, vice president

Project Manager:
Frederick P. Fink

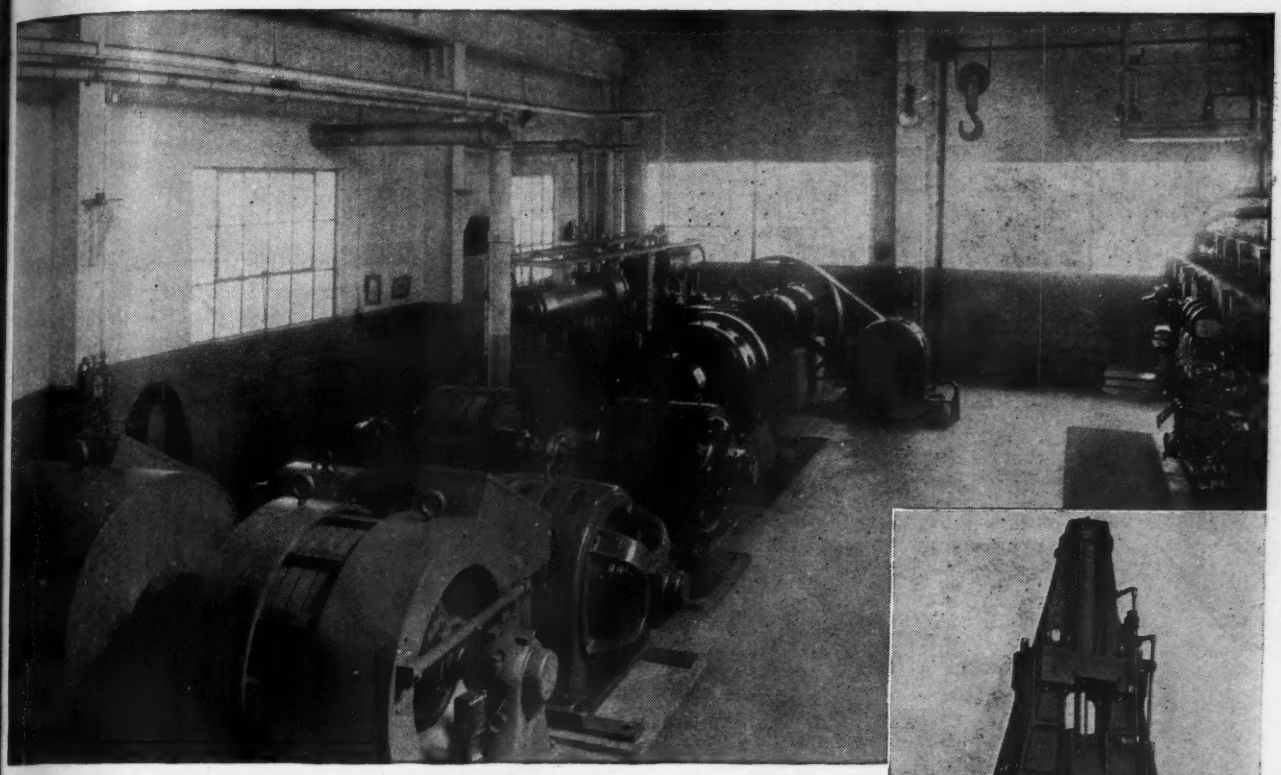
Job Superintendents:
Louis Pampke
Charles Caruso

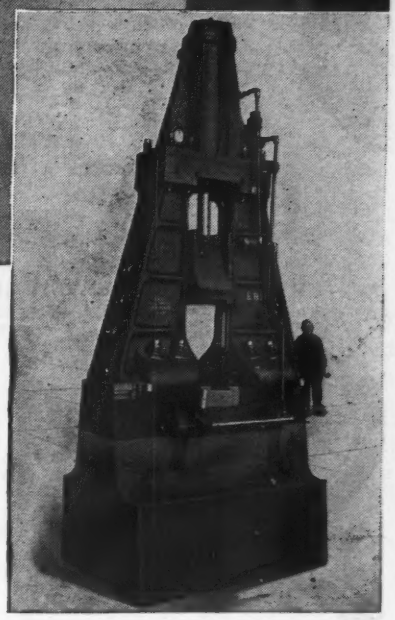
L. K. COMSTOCK AND COMPANY
and
BRYANT ELECTRIC COMPANY, INC.

General Direction:
G. E. Steward, President, L. K. Comstock and Company

Resident manager:
Hobert M. Bryant, Bryant Electric Company, Inc.

Project Manager:
J. E. Metzger, L. K. Comstock and





IN THE PLANT OF THE WORLD'S LARGEST BUILDER OF STEAM HAMMERS

BURKE has a *40 Year Record*

ILLUSTRATED ABOVE are shown front to rear the following BURKE UNITS in the plant of the Erie Foundry Company.

For D C Power Requirements:
1—400 K. W. Synchronous M-G Set.
1—200 K. W. " " "
1—150 K. W. " " "

For Driving Air Compressors:
1—100 H. P. Synchronous MOTOR (Direct Drive)
1— 60 H. P. Induction MOTOR (Belt Drive)

For over 40 years, the Erie Foundry Co., world's largest builder of steam hammers, has indicated its approval of Burke Motors and Generators by their long continued use in the power plant pictured above.

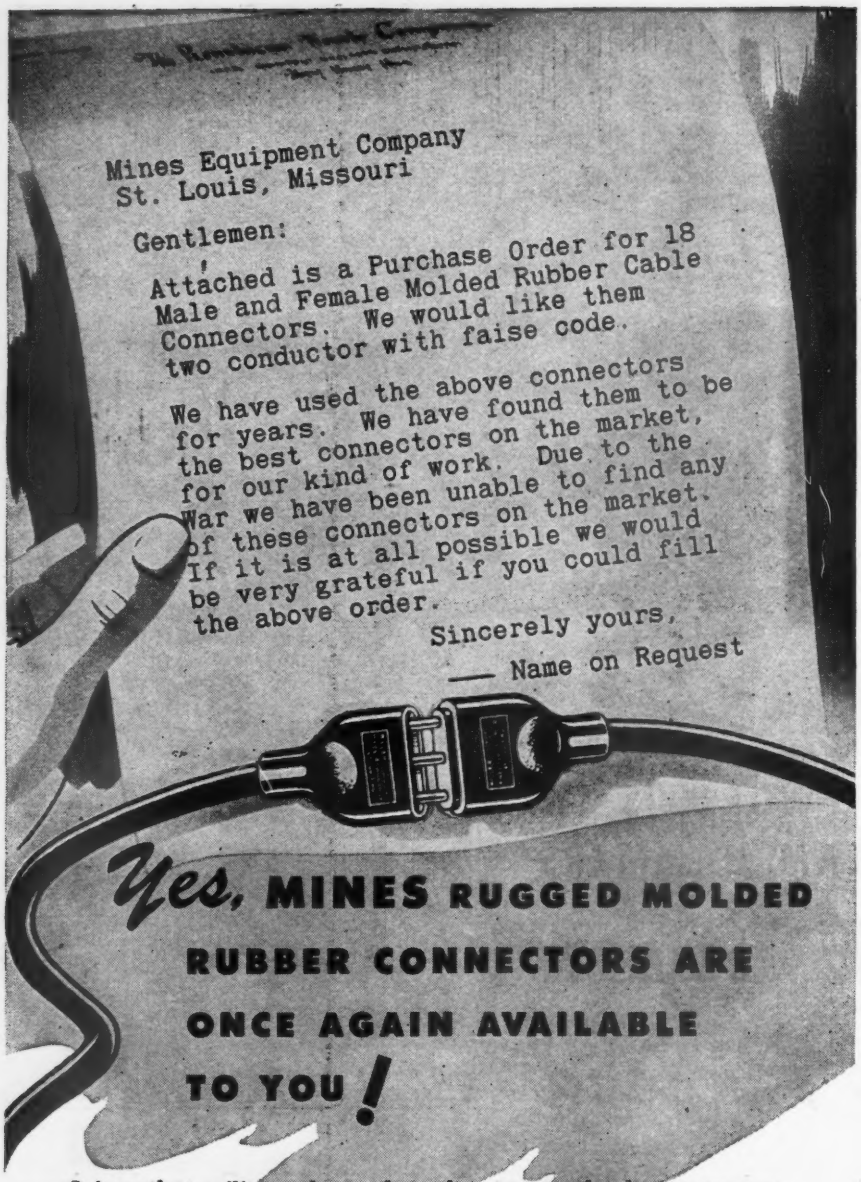
For 54 years, Burke has built motors and generators to the specific requirements of industry. This long record of designing for the job, rather than to a compromise standard, has given us a flexibility that continues to prove valuable, wherever *a better than standard* electrical unit is desired.

Burke engineers can assist you in the selection of Burke Motors and Generators that will provide continuous, dependable service. *Write Burke Electric Co., 13510 W. 12th St., Erie, Pa.*

MOTORS 1 TO 1500 H. P. • GENERATORS 1 TO 1000 K. W.

BURKE A.C. & D.C. Motors & Generators

BURKE ELECTRIC COMPANY, ERIE, PENNSYLVANIA • Since 1891


Mines Equipment Company
St. Louis, Missouri
Gentlemen:
Attached is a Purchase Order for 18 Male and Female Molded Rubber Cable Connectors. We would like them two conductor with faise code.
We have used the above connectors for years. We have found them to be the best connectors on the market, for our kind of work. Due to the War we have been unable to find any of these connectors on the market. If it is at all possible we would be very grateful if you could fill the above order.
Sincerely yours,
— Name on Request
Yes, MINES RUGGED MOLDED RUBBER CONNECTORS ARE ONCE AGAIN AVAILABLE TO YOU!

Now that military demands no longer completely tax our production facilities, we are able once again to supply Mines Molded Rubber Cable Connectors to all industry.

Mines Connectors when molded to electric cable become a part of the cable itself, giving a safe, efficient, water sealed connection. Mines Connectors can be furnished for splicing to cable in your own plant or molded to specified cable lengths.

Our engineers will gladly work with you in solving portable cable applications. Mines Connectors are available in single or multi-conductor, on capacities up to 5000 volts and 325 amperes.

For efficient, safe, flexible electric power transmission by cable, use Mines Connectors—"The Connector With The Water Seal."

WRITE FOR BULLETIN MC-106, showing many successful applications of Mines Connectors throughout industry.

MINES EQUIPMENT COMPANY

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Company (October, 1943, to June, 1944) Howard R. Pancoast, Bryant Electric Company, Inc. (June, 1944, to July, 1945) William H. Rigby, Bryant Electric Company, Inc. (Since July, 1945)

Chief Engineer:
James R. Siebert, Bryant Electric Company, Inc.

General Construction Superintendent:
Charles Scharfe, L. K. Comstock and Company (January to June, 1944)
Joseph J. Bartlett, Bryant Electric Company, Inc. (Since June, 1944)

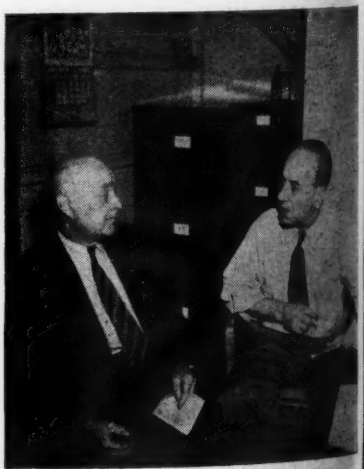
Liaison Engineer:
J. A. Walsh, L. K. Comstock and Company

CALIFORNIA ELECTRICAL CONTRACTORS MEET

To discuss the advisability of forming a state association, electrical contractors from both northern California and southern California met at Hotel Fresno on August 18th. Although members of both Los Angeles chapter and Northern California chapter NECA were present, the meeting was not sponsored by either group. It was rather to discuss the feasibility and the need for a state association to handle statewide matters.

Chairmanship of the meeting was divided between the two groups; Tom Harris, H. S. Tittle Company, San Francisco acted as temporary chairman in the morning session and Herbert Evans, Nicholas Electric Company, Hollywood, was chairman for the afternoon meeting.

A committee was elected to work out details for such a statewide organization and to report at a future meeting, probably in January. The committee consists of L. G. Jeffrey, Electric Construction Co., Fresno, Walter Vance, Jr., Pacific Electric Motors Co., Oakland, Tom Har-



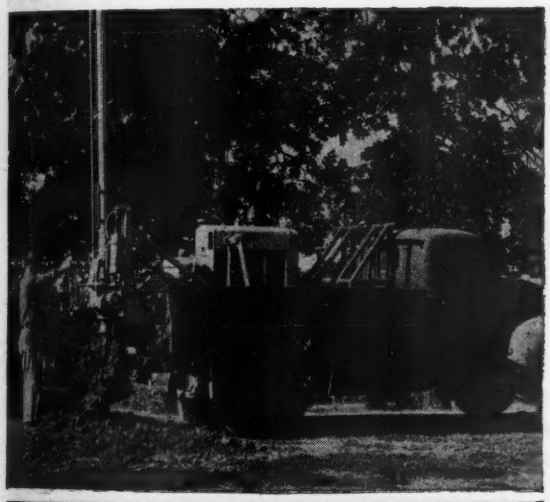
Electrical alterations are being discussed by (L to R) Milton E. Reading, electrical inspector of the City of Detroit (assigned to reconversion work) and Harry W. Schuler, chief electrician of the General Motors Office Building in Detroit.

JAQUES
EARTH BORING MACHINE

Does the Job Quicker

Hydraulically controlled to insure ease of operation and provide automatic regulation of cutting speed to suit the texture of the soil, this new, improved JAQUES EARTH BORING MACHINE does the job better, quicker—at a saving both in manpower and cost.

If you have an earth boring job to do, here's the machine to use. Note some of its principal features.



1. **EASE OF OPERATION**—All hydraulic controls readily accessible to operator. No manual labor required.
2. **HYDRAULIC PLUMBING**—Controlled by hydraulic power.
3. **SPEED**—The hydraulic feed automatically regulates the speed of cutting to suit the texture of the soil. Holes are dug faster.
4. **SELF-CONTAINED UNIT**—When not in use, this machine can easily be removed from truck and stored.
5. **POWER**—Auxiliary motor of ample capacity—truck motor not used in boring.
6. **ANCHOR HOLES**—Anchor holes as well as vertical holes may easily be bored.
7. **SIZE AND DEPTH OF HOLE**—Any size up to twenty-four inch diameter bit may be used and hole may be bored to a depth of eight or nine feet.
8. **WEIGHT**—3,400 lbs. complete.

If you have a tough earth boring job to do, entrust the job to JAQUES. Wire or write for full information and prices today.

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Highway 75 Denison, Texas

Prompt deliveries are again a reality on ROYAL-NOARK Non-Renewable Fuses. Orders will have our immediate attention... send yours TODAY

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WIRE • CORD SETS • CARTRIDGE and PLUG FUSES • FUSTATS • TROUBLE LIGHTS • CHRISTMAS LIGHTING SETS

ROYAL ELECTRIC CO., Inc., PAWTUCKET, R. I.

ris, Norman Ferguson, California Electric Works, San Diego and J. C. Schamel, Schamel Electric Co., Los Angeles.

In this one day session other subjects discussed were direct sales to industrials and wholesaler and manufacturer policy, statewide apprenticeship program, the state contractors license law, disposal of surplus materials through the RFC, re-manning of inspection departments and various postwar subjects in which contractors may be interested.

Roy Butcher, San Jose electrical contractor, a member of the state contractors license board was unanimously endorsed for reappointment by the governor and recommendation to that effect is to be made by the contractors.

Discussing a master agreement, which is to be used as a guide and a model for the making of local agreements, Tom Harris, chairman of the committee from the Northern California chapter NECA, which worked out such an agreement, recommended similar action in the southern part of the state. It was agreed that neither group would approve labor agreements without consulting each other in order that uniformity of rules and working conditions might be obtained throughout the state.

Opposition was voiced to the proposed Murray Dingle bill now before Congress for the creation of work.

The statewide meeting of electrical contractors early next year was advocated and unanimously voted upon. No permanent organization was set up in the Fresno meeting, that being left to the development of the special committee appointed for that purpose.

AA RATINGS NOW VOID

Orders rated AA which were originally accepted and scheduled for delivery by September 30 but which due to circumstances beyond the supplier's control are delayed in delivery, are void after that date, and must be treated as unrated, the War Production Board has explained.

The explanation was contained in Interpretation 1 to Priorities Regulation 29. The regulation provides that the AA rating system remains effective only as to deliveries until the end of September 1945 and that after that time AA ratings must be disregarded by suppliers.

Where a supplier receives a purchase order for delivery before October 1, but is unable to schedule it for delivery until after September 30, he must treat it as an unrated order under paragraph (c) (2) of PR 29, the interpretation says. Suppliers, of course, must follow the requirements of PR 1 in accepting and scheduling AA rated orders for delivery before October 1.

The same rules apply to treatment of authorized controlled material orders under paragraph (d) of PR 29, the interpretation says. This paragraph states that the Controlled Materials Plan and all regulations and directions under it

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Now Available Without Restrictions

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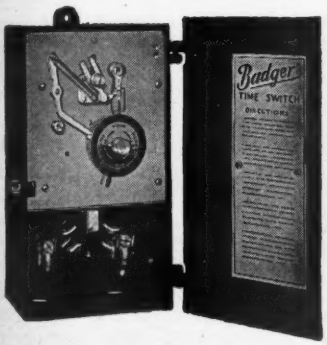

BADGER Synchronous Automatic Time Switches

Heavy duty time switch with capacity to meet a wide variety of requirements.

RELIANCE Model W Synchronous Electric Time Switches

Completely automatic—extremely simple, compact, economical—three types cover practically every requirement. Built to highest standards of accuracy.

THE dependability of RELIANCE Automatic Time Switches has been proved in emergency as well as in normal times. They are giving complete and reliable service under many varied conditions—a factor of paramount importance when constant good service is essential.

RELIANCE switches are easy to install, economical in operation, and meet a wide variety of needs. The present sales possibilities should interest you—tap this rich source of today's business.

Catalog and price sheets available on request.

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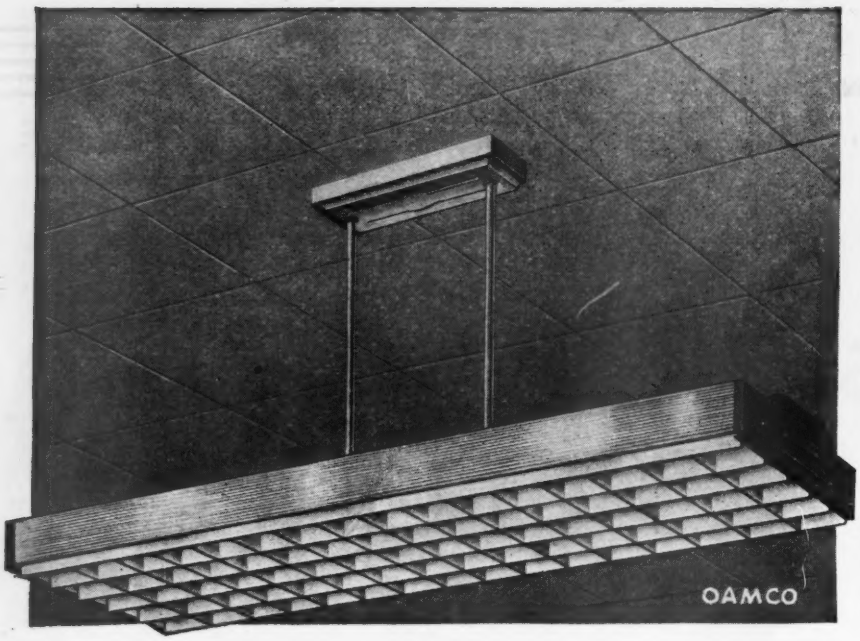
RACINE, WISCONSIN



Fluorescent Commercials

FOR RIGHT WORK LIGHT

The new OAMCO Egg Crate Louver Commercial Fluorescent Fixtures are designed and constructed to give high intensity illumination in stores, offices, drafting rooms and general working areas where maximum light plus fixture beauty are essential. These All-Steel Fluorescent Commercials have a welded steel louver finished in reflector white, side panels of diffusing ribbed glass and satin aluminum finished end covers, canopies and stems. The above units are furnished in the four 40-watt size for suspension or ceiling mounting and come completely wired including lamp holders, starters and high power factor ballasts.

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(except inventory restrictions) will automatically expire on October 1 and that until the end of September, deliveries of controlled materials will continue to be regulated by CMP alone and not by ratings. However, an order for controlled materials rated AAA, MM or CC, calling for delivery before October 1, is to be treated as an authorized controlled material order, PR 29 states. On orders other than controlled material orders during the period until the end of September, the MM rating is equivalent to AA-1 and the CC rating is equivalent to AA-2.

A different rule applies to AA ratings for orders for textiles and related items covered by Schedule A of Order M-328, the interpretation points out. These AA ratings remain effective until September 30 both on orders for delivery before and after that date. Orders with AA ratings must, until September 30, be accepted and scheduled as in the past, even if they call for delivery after September 30. After that date the AA ratings are ineffective and orders bearing them must be treated as unrated specifically re-rated AAA, MM or CC.

CONSTRUCTION PROGRAM UNDER WAY

The country's vast program of new construction, aimed at reducing unemployment and expanding peacetime production, is well under way, according to the War Production Board's first monthly report on "Construction for Reconversion," J. A. Krug, WPB chairman has announced.

He disclosed that a survey of 41 selected industries, covering 4,101 companies throughout the entire United States showed that the value of construction, tools and equipment projects now under way or planned for completion within the next twelve months totaled $520,225,000.

This figure for the 41 industries, Mr. Krug pointed out, does not cover the whole reconversion field, but merely indicates the trend. Future surveys will broaden the coverage to give a more complete picture of what is under way. Furthermore, all reconversion industries as a group account for only a fraction of the total industrial plant and equipment expansion planned for the next year. Prominent examples of plant and equipment expansion, other than in the reconversion industries, are in the food processing and textile fields.

"Construction has always been a major factor in providing jobs," Mr. Krug said, "and it will become an even greater user of manpower in the months to come. During 1945, more than 700,000 persons have been employed monthly in the construction industry. By 1946, this number is expected to increase to more than a million. This does not include employment generated by maintenance and repair activity, which in dollar volume for 1946 is likely to run well over $4,000,000,000. And of course, there is an enormous amount of indirect employment among

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Quickly-Easily-Accurately...

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A quick glance at this handy, easy-to-use Varnish Selector gives you all the facts on 7 outstanding insulating varnishes — characteristics, applications, baking and drying time, base, thinner, viscosity — everything you want to know. Ask your local G-E Merchandise Distributor for one and you'll always have this essential information at your finger tips, ready to use. A list of G-E Distributors is available on request from Section RIM252-11, Resin and Insulation Materials Division, General Electric Company, Schenectady 5, New York.

SEND THIS COUPON NOW TO YOUR LOCAL G-E MERCHANDISE DISTRIBUTOR

Gentlemen:

Please send me a G-E Insulating Varnish Selector as offered in Electrical Contracting.

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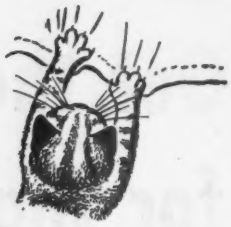
GENERAL ELECTRIC

IT'S FRESH AS A DAISY...

CELLOPHANE-SEALED — then individually boxed—every roll of Jenkins Gold Seal Friction Tape is bound to reach you factory-fresh!

WON'T RAVEL OR PEEL...



IT WON'T smudge hands either... and it won't dry out on the shelf or job, thanks to quality control of fibre and friction compound.

IT STICKS LIKE A LEECH...

HOT weather or cold, Gold Seal Friction Tape always has the right amount of Tack ... always sticks to the job — but never to the hands!

..IT'S JENKINS GOLD SEAL!

MADE BY the makers of Jenkins Diamond Seal Friction and Rubber Tapes — both of which meet ASTM and Federal specifications.

JENKINS *Gold Seal Tapes*

Jenkins Bros., Rubber Div., 80 White St., New York 13, N. Y.

FRICTION ... RUBBER

Your customers will THANK YOU and CALL AGAIN

when you sell them SPEER BRUSHES

When motor users ask, "What's a good buy in brushes?" and you say "SPEER!", you've said *Hello!* to regular customers, for SPEER brushes bring 'em back for more. They'll *thank you* for the service and *call again* for an order of the same. SPEER brushes give the kind of performance that makes them say "Encore! Encore!"

When you stock the all-inclusive line of SPEER brushes—an easy-to-handle shelf item—every motor user is a good prospect for you. SPEER brushes have an extra "in" with motor users everywhere ... a fifty-year-old reputation for quality, service and satisfaction. Make SPEER your "spearhead" when you enter the vigorous competition for your share in post-war business. Write for details.

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SPEER
CARBON COMPANY
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222

the suppliers of materials for such a construction boom period."

The construction report released today is the first of a monthly series to be made by WPB and forecasts, on studies made by the Construction Research Branch of WPB, that total new construction in 1946 is expected to reach approximately $6,500,000,000, a 44 percent rise from the 1945 level. The bulk of the over-all increase will be privately-financed activity amounting to an estimated $4,350,000,000, an increase of 73 percent over 1945 and a half billion dollars more than was spent in 1939.

Commenting on present construction trends, the report points out that the shift from publicly-financed to privately-financed construction is already apparent. In August of this year, privately-financed construction of all kinds totaled $256,000,000, a 12 percent increase over this type of construction in August 1944. Principal advance was for commercial, hospital, educational, and recreational structures ($35,000,000), a rise of 21 percent from the amount spent in August of last year. The volume of private factory building also rose to a total of $60,000,000, representing three times the volume of put-in-place privately-financed factory construction in August 1944.

Publicly-financed construction activity in August 1945 declined sharply to $163,000,000 as a result of the stoppage of a large number of military and industrial jobs immediately following the end of hostilities. Government financed industrial construction fell off 33 percent from July, with non-industrial military construction dropping 25 percent.

For the fourth quarter of 1945, the estimated over-all volume of construction is expected to amount to $1,167,000,000, almost 10 percent more than the volume expected, had the war continued. Privately-financed construction is expected to make up $785,000,000 of the total fourth quarter volume.

The largest volume of private work is expected in factory building, which will amount to an estimated $206,000,000 of put-in-place construction. This figure represents almost three times the volume of private factory construction in the fourth quarter of 1944 and is well above the average quarterly rate of $169,000,000 for this type of construction in 1941.

Channeling of construction activity into the industrial field to speed up reconversion will result in a relatively slower expansion of residential building in both the third and fourth quarters of 1945, the report said.

The upward trend of privately-financed factory construction is expected to continue at an accelerated rate in 1946, as reconversion activity speeds up. An estimated $950,000,000 will be spent for this type of construction, the highest annual rate to date.

Privately-financed residential construction, unlike industrial building, will only begin to approach the full scale postwar level in 1946, with an estimated volume of $1,525,000,000. This figure, it was pointed out, is nearly two and one half times the expected 1945 volume for privately-financed residential construction.

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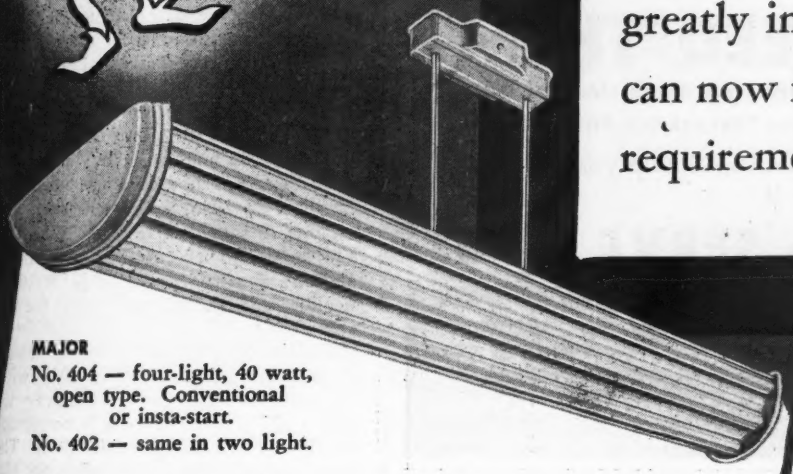
Announcing

Production facilities on "Firefly Fixtures" have been greatly increased so that we can now fulfill your delivery requirements.



MAJOR
No. 404 — four-light, 40 watt, open type. Conventional or insta-start.
No. 402 — same in two light.

Order "Firefly" fluorescent fixtures through your jobber . . . if he cannot supply you, write direct to us . . . we will fulfill your order promptly THROUGH your local jobber . . . or advise you as to our representation in your territory.

20 and 40 watt STRIP LIGHTING available for immediate delivery

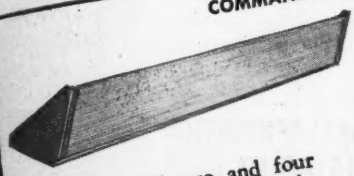
INDUSTRIAL-LITE

702E Ballast type and 702EX (insta-start). All steel high quality two light units.

703 — three light industrial.

702T with GE Turret sockets, two light unit.

COMMANDER



A beautiful 48" two and four light glass covered unit. Side prismatic glass panels are easily removed for maintenance. Designed for pendant hanging or flush-mounting. Ballast or Insta-Start.

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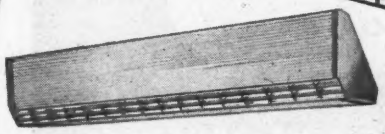
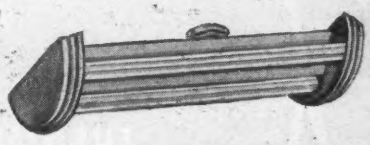


48" Glass and louvered two and four light unit. Ideal where quality lighting is desired. Insta-Start or Ballast type.

CHAMPION



A quality engineered Kitchen two light unit at a competitive price . . . also available in three and four light models.

Terminal connectors used on all stripped wire ends . . . a real service to the contractor and maintenance man.

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MANUFACTURERS OF "ALL-BRITE"

Built with Precision

COMMUTATORS WHEN YOU NEED THEM—

We are "building up," our inventories on stock sizes of Commutators to be in a position to give you fast service on most sizes.

Our Commutator Data Book will help you Write for it.

3 FACTORIES to SERVE YOU

TOLEDO STANDARD COMMUTATOR CO. – Toledo 6, Ohio
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HILLSDALE COMMUTATOR CO. – Hillsdale, Michigan
THE NATION'S LARGEST EXCLUSIVE MANUFACTURERS OF QUALITY COMMUTATORS

THE IWI MAN WITH A WISE PLAN *points out that*

OHIO CARBON COMPANY

FURNISHES FINE BRUSHES AND BURNISHERS . . . .

To give you the proper finishing touches to motor repairs and final commutator turning jobs. Easy to use carbon brushes and burnishers that do the work while the machine is running are listed in the Blue Catalog.

INSULATION AND WIRES IWI SERVICE

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Restrictions imposed on the home building industry since 1942 as a result of war conditions will prevent the industry from undertaking a larger volume of activity in 1946, even though present shortages of materials and manpower ease up in the near future.

Government-financed residential work in 1946 is expected to be 76 percent higher than that for 1945.

Non-residential building (other than industrial and military but including commercial) is expected to amount to $1,145,000,000 in 1946, twice the volume of this type of construction in 1945. The anticipated 1946 rate will neither approach the rate of good pre-war building years, nor will it be more than a beginning of the program necessary effectively to reduce the pent-up demand for building in this field. This type of construction felt the impact of war limitations more severely than all other types, and in 1943 the total volume had declined to an all-time low of $96,000,000 or little more than 5 percent of the annual rate of the 1920's.

A sharp decline in military and government-financed industrial construction is expected in 1946, with work at military establishments estimated at $125,000,000, a drop of 76 percent from 1945 and industrial work forecast at $75,000,000, a decline of 88 percent from the 1945 volume.

Public construction work is expected to increase substantially in 1946, with a 134 percent increase in highway work and a 127 percent increase in conservation work, as compared with 1945. These increases will more than offset the sharp decline in military and government financed industrial construction, it was pointed out.

Though new farm construction and utilities construction have not felt the effects of wartime limitations as severely as other types, work in these fields is also expected to show substantial gains in 1946. Farm work in 1946 is estimated at $330,000,000, a 50 percent increase over 1945, and the volume of construction in utilities is placed at $850,000,000, a 30 percent increase over 1945.

INTERPRETATION 2 TO PR 27

Small manufacturers, operating under Priorities Regulation No. 27, were notified by the War Production Board that despite the directions of earlier regulations, they would not be permitted to use their AA-4 rating and Z-3 allotment symbol after September 30, 1945.

Interpretation 2 to PR 27, issued recently, calls attention to the fact that despite the provisions of the regulation that permit the use of the rating and allotment symbol to December 31, issuance of PR 29, has shortened the period so that AA ratings and Z symbols will be invalidated after September 30.

Manufacturers operating under PR 27, who need priorities assistance after September 30 may apply under the terms of PR 28, provided they can meet the conditions.

MANY EMERGENCY FEDERAL SPECIFICATIONS CANCELLED

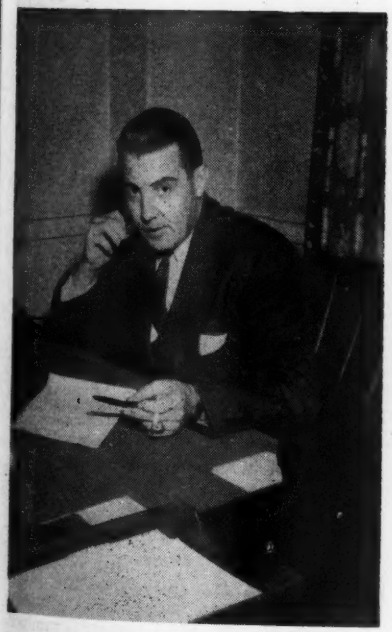
Cancellation of 400 out of a total of 492 emergency alternate Federal specifications, devised to provide substitutes for critical materials used in items purchased by the Government during the war, was announced by the War Production Board.

WPB said that these emergency specifications had been developed at the suggestion of the Conservation and Salvage Division, working in collaboration with the 73 regularly constituted technical committees on Federal specifications. The substitution effected resulted in a substantial saving in critical materials needed in war production and thereby materially contributed to the maintenance of such production.

Eighty-five additional emergency specifications are in process of cancellation or will be incorporated into basic Federal specifications where they have been found to be superior to the former product, WPB said. The remaining seven will be retained until tin, burlap, rubber and other materials become more plentiful.

Harlan W. Bird, formerly of Chicago, of the Conservation and Salvage Division has served as official technical liaison officer between WPB and the other Government departments on specification problems since 1941, when he joined the staff of the Office of Production Management.

In announcing the cancellations, WPB expressed the agency's appreciation of the cooperation given throughout the program by the Director of Procurement, the National Bureau of Standards, the War and Navy Departments and by members of the technical committees.



Sterling E. Melcher, secretary-manager of the Detroit Electrical Contractors Association, has the tough job of helping solve the labor shortage, jurisdictional and overtime wage rate problems in Detroit's electrical construction industry.

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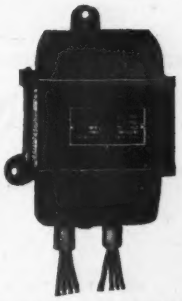
TRANSFORMERS

Increase Efficiency

Improve Distribution

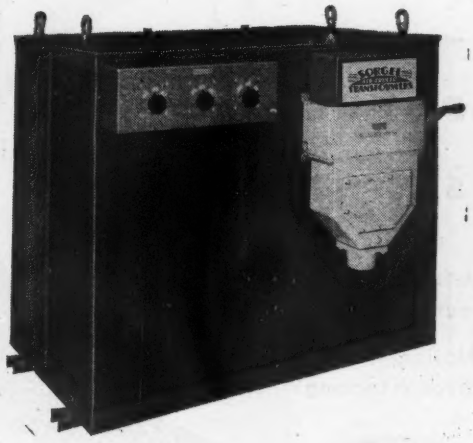
Install SORGEL *Air-Cooled* Transformers at load centers and where power is needed.

Can be installed easily in most any convenient place in the building — on wall, post, ceiling, or floor — without fire-proof vaults or enclosures.

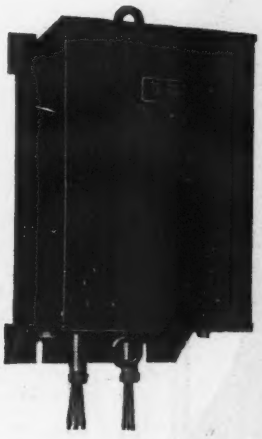


Standard ¼ KVA. 1-phase 460/230 to 230/115 volt

A size and type for every purpose ¼ to 1000 KVA. All voltages.



450 KVA. 3-phase. 4160 volt.



Standard 15 KVA. 1-phase Wall Mounting Type

SORGEL ELECTRIC CO., 836 W. National Ave., Milwaukee 4, Wis.

Pioneers in the development and manufacturing of Air-Cooled transformers.

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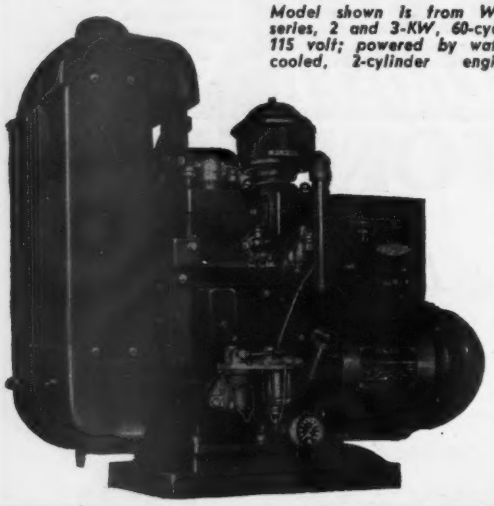
Reliable, economical electric service for electrical contracting projects anywhere, anytime, with an Onan Electric Generating Plant. From the 65 basic models, the right plant for any job or application, large or small, can be selected.

Driven by Onan built, 4-cycle gasoline engines, these power plants are of single-unit, compact design and sturdy construction. Suitable for all mobile, stationary or emergency service.

Model shown is from W2C series, 2 and 3-KW, 60-cycle, 115 volt; powered by water-cooled, 2-cylinder engine.



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Models range from 350 to 35,000 watts. A. C. types from 115 to 660 volts; 50, 60, 180 cycles, single or 3-phase; 400, 500, and 800 cycle, single phase; also special frequencies. D. C. types range from 6 to 4000 volts. Dual voltage types, available. Write for engineering assistance or detailed literature.

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P. S. MILLAR AWARDED I.E.S. GOLD MEDAL

The I. E. S. Gold Medal, given by the Illuminating Engineering Society as highest honor in the field of lighting, has been awarded to Preston S. Millar, President of the Electrical Testing Laboratories, Inc., New York City. The I. E. S. Gold Medal is awarded to eligible candidates from the fields of engineering, design, applied illumination, optics, ophthalmology, lighting research, education or administration "in recognition of meritorious achievement which has conspicuously furthered the profession, art, or knowledge of illuminating engineering."

Mr. Millar's contributions to illuminating engineering have most certainly "conspicuously furthered the profession, art and knowledge." A Charter member of the Illuminating Engineering Society, and in 1913 its eighth President, he has for nearly 50 years been an outstanding influence in the lighting field.

He is one of the organizers of the present Electrical Testing Laboratories, Inc., which stands as one of the leading institutions of its kind and an important factor in the application of the ideals and technical thought in illuminating engineering.

He was co-developer with the late Dr. C. H. Sharp of the Sharp-Millar Photometer which helped provide more accurate measurements of illumination and thus advanced the scientific basis of lighting practice.

Throughout the years he has exercised a strong influence on the advances made in street lighting practice. His studies on the subject of silhouette vision, demonstrated at the Convention of the Illuminating Engineering Society in 1910, has a marked influence on the thinking of engineers and led to a better understanding of the art of street lighting. Under his guidance as chairman and member of the I. E. S. Committee on Street Lighting, of which he is still a member, street lighting practice acquired a general engineering agreement as expressed in codes of the I. E. S.

Even with 50 years of invaluable service behind him, Mr. Millar is still an enthusiastic leader in the illuminating engineering profession and an active worker in the lighting industry. In addition to his activities as President of the Elecrical Testing Laboratories, he is a contributing member on various I. E. S. committees and a prominent influence in the lighting field.

The I. E. S. Medal Committee making the recommendation was: George H. Stickney, Chairman (1944 Medallist), Leland H. Brown, Professor of Illuminating Engineering, Stanford University, R. B. Brown, Jr., Boston Edison Company, E. C. Crittenden, National Bureau of Standards, P. H. Goodell, Trumbull Electric Mfg. Company, Professor H. H. Higbie, University of Michigan, P. M. Rutherford, Jr., Dallas Power & Light Co., and Howard M. Sharp, Buffalo, Niagara and Eastern Power Corporation, Buffalo, N. Y.

APPRENTICES NEEDED IN BUILDING TRADES

Because it has found that there are not enough skilled workers for the expected postwar building needs, the construction industry is seeking an immediate and marked increase in the number of apprentices in the building trades, the War Manpower Commission's Apprentice-Training Service announced recently.

A study by the Apprentice-Training Service, just completed, shows that:

The average age of construction men has increased from about 38½ years in 1900 to 43 years in 1940 and the proportion of youths under 20 years old being trained to replace the older age group dropped fully six percent during this period.

If workers 65 years of age or older were suddenly to retire, several of the building trades would suffer from severe shortages of skilled labor because there are not enough young journeymen and apprentices to replace them.

Many retirements and deaths before 65 would make the situation in the construction industry even more critical.

If projected plans for an expanding construction economy are carried out, the actual ratio of replacements will be entirely inadequate.

To meet this situation, the construction industry, through its General Committee on Apprenticeship for the Construction Industry, consisting of leading contractors and union officials, has urged that each local union and employer association in the industry renew and extend its activities to develop more apprentices within their crafts, and that a "uniform, sound policy be developed in handling returned veterans in terms of Public Law 346, (G. I. Bill) and in terms of its application," according to ATS.

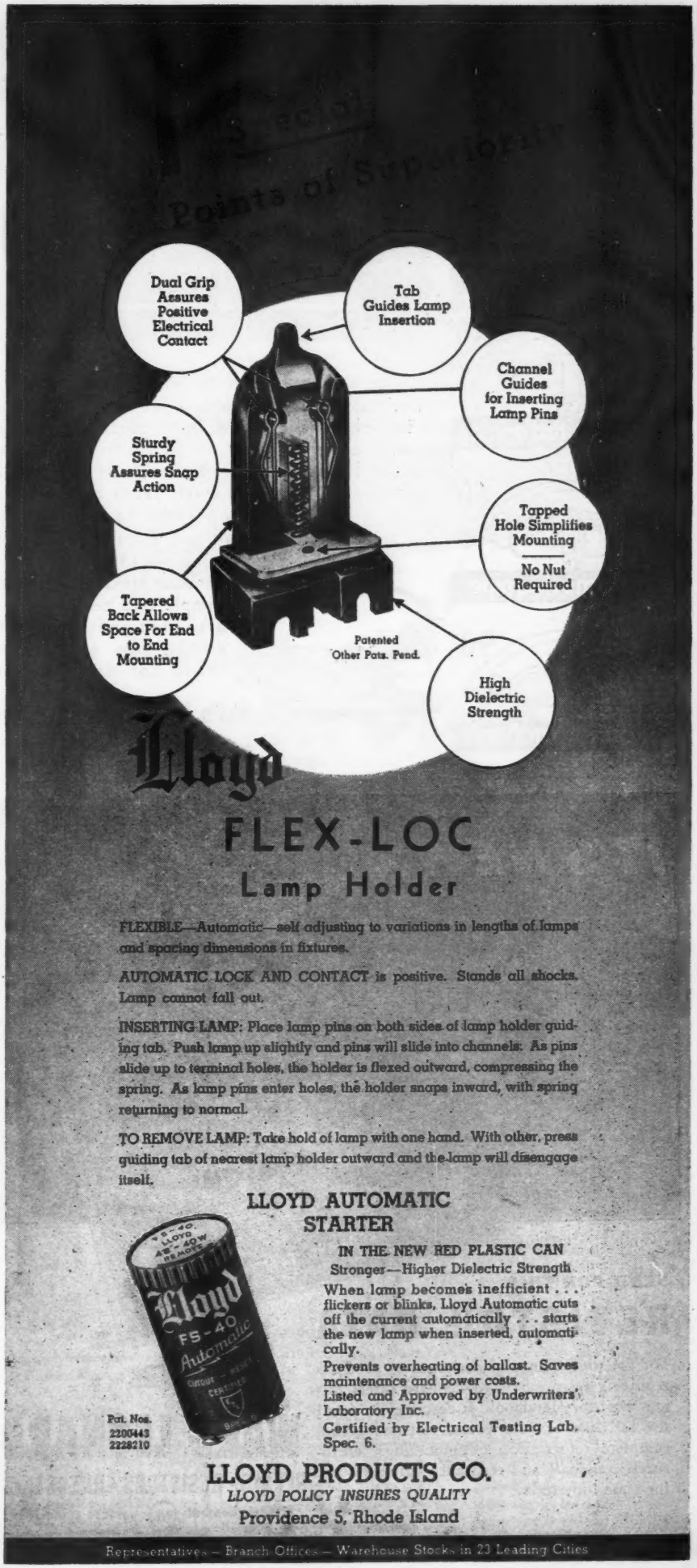
Results of a study made by the Apprentice-Training Service at the request of the General Committee on Apprenticeship for the Construction Industry were submitted to the executive committee of the general committee.

The committee reported that the war period and the depression years that preceded it were not conducive to the training of craftsmen in the numbers needed.

The committee reported:

"In 1940 there were 2,016,453 craftsmen and 25,269 apprentices in the construction industry. To maintain this number of craftsmen we must train not 25,000 or 30,000, but at least two or three times that number of apprentices so that 40,000 will complete their training each year and take their places in the trades as all-round skilled workers."

To increase the number of apprentices required to meet the greatly expanded postwar needs for housing and major construction, specific plans have been made nationally and locally, according to ATS, to further the employment of returning veterans. It pointed out that employment of veterans in the construction trades apprenticeship program will not only help industry in providing the skilled workers who are needed, but also will provide career opportunities for veterans who qualify.


Dual Grip Assures Positive Electrical Contact
Tab Guides Lamp Insertion
Channel Guides for Inserting Lamp Pins
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Tapped Hole Simplifies Mounting
No Nut Required
Tapered Back Allows Space For End to End Mounting
Patented
Other Pats. Pend.
High Dielectric Strength
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FLEX-LOC
Lamp Holder
FLEXIBLE—Automatic—self adjusting to variations in lengths of lamps and spacing dimensions in fixtures.
AUTOMATIC LOCK AND CONTACT is positive. Stands all shocks. Lamp cannot fall out.
INSERTING LAMP: Place lamp pins on both sides of lamp holder guiding tab. Push lamp up slightly and pins will slide into channels. As pins slide up to terminal holes, the holder is flexed outward, compressing the spring. As lamp pins enter holes, the holder snaps inward, with spring returning to normal.
TO REMOVE LAMP: Take hold of lamp with one hand. With other, press guiding tab of nearest lamp holder outward and the lamp will disengage itself.
LLOYD AUTOMATIC STARTER
IN THE NEW RED PLASTIC CAN
Stronger—Higher Dielectric Strength
When lamp becomes inefficient . . . flickers or blinks, Lloyd Automatic cuts off the current automatically . . . starts the new lamp when inserted, automatically.
Prevents overheating of ballast. Saves maintenance and power costs.
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The General Committee on Apprenticeships for the Construction Industry has formulated plans whereby the ATS State apprenticeship agencies and the Veterans Administration may work together under a uniform policy in the employment of former servicemen who wish to train for construction work.

Nation-wide apprentice-training programs have been established for the following trades: carpenter, electrician, plumber, steamfitter and painter and decorator. National management and labor groups in the following trades are presently working on similar apprenticeship programs: stained glass worker, plasterer, tile setter, bricklayer and cement finisher.

MINNESOTA COUNCIL HELPS CREDIT WAR VETS

The Minnesota Electrical Council, Minneapolis, has taken steps to assure that war veterans returning to civilian life will receive proper credits for work in the electrical field. Although many may have had four years of training in radar and be well informed in the fundamentals of electricity, electronics and communications, they might have few qualifications for working on residential, commercial and industrial electrical installations.

In fairness to the returning veteran and to the consumers who may use his services, some means must be devised to determine what credit he should be given on the general experience requirements of the state law. To this end, the Council has appointed a committee to work with the State Board of Electricity in an effort to establish a fair method of establishing such credits.

Members of the committee are: D. F. Kehne, St. Paul; O. H. Batzli, Minneapolis; Eric Nylund, Duluth; E. W. Linner, Stillwater; and William A. Ritt, secretary-manager of the Council. This action followed a presentation of the problem to the directors of the Minnesota Electrical Council at a recent meeting by Sam Newstone, Montevideo, a member of the State Board of Electricity.

PFALTZ JOINS STAFF OF NEWA

Albert Pfaltz has joined the staff of the National Electrical Wholesalers Association to engage in public relations and promotional activities for that organization.

Formerly associated with the National Electrical Manufacturers Association for more than ten years as publicity director and a member of the senior staff, Mr. Pfaltz assisted in the organization of the National Adequate Wiring Program, the Rural Electrification Bureau and programs of the Electronics and Lighting Equipment Sections. He was editor of the *Adequate Wiring Reporter* and

NEMA News and, during the war period, worked with the postwar planning and public information committees.

Before joining NEWA, Mr. Pfaltz was director of public relations of the Society of the Plastics Industry, from which group he recently resigned.

NEBRASKA AND WESTERN IOWA CHAPTER OF NECA FORMED

Nearly 40 electrical contractors have organized the Nebraska and Western Iowa chapter of the National Electrical Contractors Association. The officers elected were S. C. Dodson, Omaha, president; A. C. Sykes, Omaha, vice president, and Martin W. Flynn, Council Bluffs, Ia., treasurer. John R. Snyder, formerly Omaha OPA official, will be secretary-manager.

In addition to the president, vice president and treasurer, directors will include E. J. Grafentin, Carl Wallin, both of Omaha, and Vernon J. Bell of Lincoln, Nebraska.

FERGUSON APPOINTED CHAIRMAN OF POSTWAR PLANNING SECTION

Whitworth Ferguson, president and founder of the Ferguson Electric Construction Company, Buffalo, N. Y., has been appointed chairman of the Postwar Planning Section of the Buffalo Chamber of Commerce.

Mr. Ferguson has just returned from a four-month secret mission to Germany where he went as a member of the U. S. Strategic Bombing Survey—a 17-man group which assessed results of American bombings of German cities.

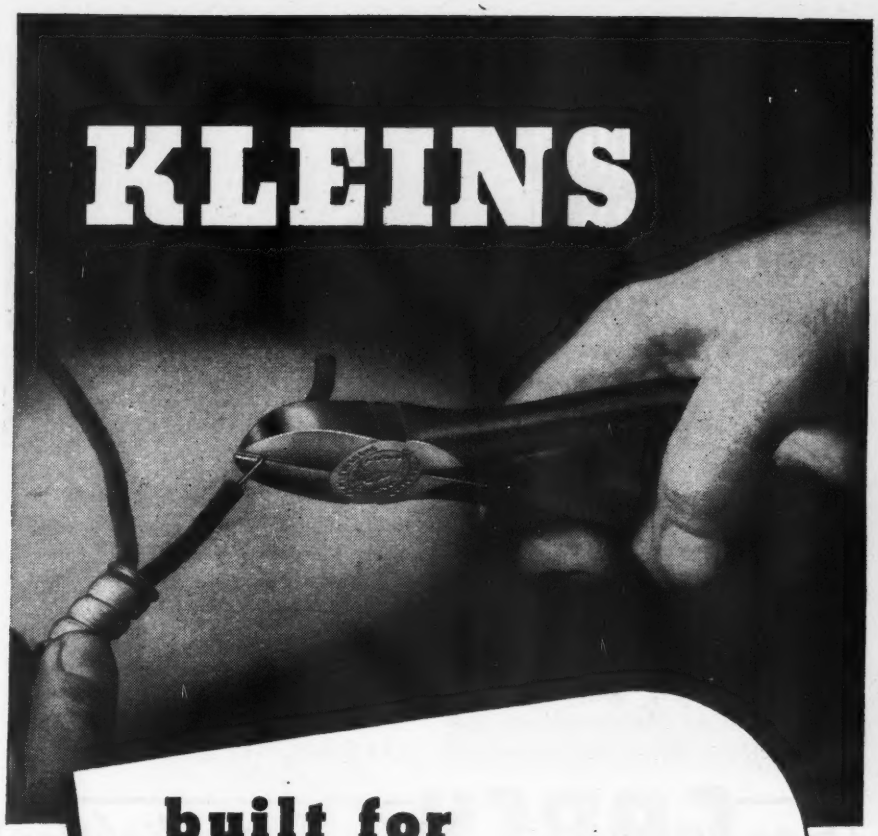
RESIDENTIAL CONSTRUCTION SHOWS INCREASE

Private home construction, in spite of wartime restrictions still in effect, is beginning to show an increase, Raymond M. Foley, Commissioner of the Federal Housing Administration of the National Housing Agency, reported recently.

Applications for insured financing on new homes to be constructed under the provisions of Title II of the FHA program averaged more than 1,000 a week during the three-month period from May through July. A substantial increase in this volume may be expected, Mr. Foley said, just as soon as remaining restrictions can be moved, and building materials, especially lumber, become available.

In July of this year, the FHA field offices received applications from private financial institutions to insure mortgages to finance the construction of 5,035 new homes of which 4,224 were to be built under the peacetime provisions of Title II.

During the same month in 1944, applications for FHA mortgage insurance totaled



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TOUGH JOBS!

● If you ever stripped tough insulation—if you ever cut through hard wire—if you ever spliced a stranded cable—you know it's a job demanding good pliers.

Kleins were designed to do the tough jobs and every lineman and electrician knows he can rely on them in the pinches as well as in the routine day's work.

The extra quality—the extra stamina—the ability to stand up day after day, year after year, in the service of men who have no time to "baby" equipment have won Kleins their reputation.

Now that the war has ended and the vast program of expansion and modernization of power and communication lines has begun, Klein tools and equipment will play their part in getting the job done quicker—in protecting the lives of the men on the poles.

This book on the care and safe use of tools will be sent on request.

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Foreign Distributor: International Standard Electric Corp., New York

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Such GARCY trade names as "Fluor-A-Case" (for display lights), "Lumi-Glass" (for signs) and "Add-A-Strip" (for strip lighting) have earned wide acceptance in commercial fluorescent lighting. Thousands of installations in stores, banks, offices, hospitals and factories provide brilliant evidence of GARCY leadership and quality.

Today, GARCY facilities are again being devoted to setting new standards in the production of quality lighting equipment.

A FEW JOBBING TERRITORIES ARE AVAILABLE. ASK US ABOUT THEM.

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INSULATION AND WIRES SERVICE

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2,792, of which all but 129 were to be built under the wartime provisions of Title VI.

"This is an indication", Mr. Foley said, "that the private home builders of America, financed by private lending institutions under the FHA program, are starting on their postwar programs to meet the nation's acute housing shortage. Builders have to have their plants ready when they apply for mortgage insurance."

The July record merely reflected the steady increase of applications for new home construction under Title II during recent months. The record since the first of the year shows 382 applications in January; 614 applications in February; 961 applications in March; 1,600 applications in April; 4,076 applications in May; 4,425 applications in June, and 4,224 applications in July.

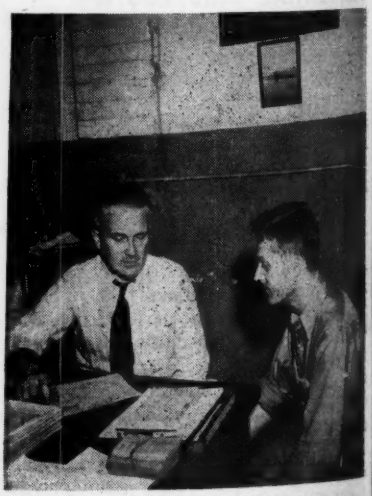
In addition, FHA's operations in insuring mortgages on existing houses during the twelve-month period ending June 30 were the largest in volume in five years.

SWPC TO CONTINUE

The Smaller War Plants Corporation will continue to make loans to small plants for civilian production, and the agency's 114 field offices throughout the country have been so notified, according to Maury Maverick, Chairman and General Manager.

The end of hostilities did not nullify the act of Congress (Public Law 603) that gave SWPC power to afford financial assistance to small manufacturers, Mr. Maverick said. On the contrary, he said, the needs of small business and our responsibilities are increased.

"Congress and the President have recognized that a general war situation will continue in the period of transition



Motor shop efficiency boost through production line techniques takes high priority in the peacetime plans of (L to R) G. C. Glenning, shop superintendent and J. G. Spaulding, Jr., secretary, of Spaulding Electric Company, Detroit.

from war to peace," the SWPC Chairman said. "This corporation clearly has a definite responsibility of assisting small business to maintain its competitive position, which is necessary to the economic stability of the nation.

"Therefore, we will continue to make available the services of this corporation to keep small business in operation during the transition from war to peace-time activities."

Mr. Maverick called particular attention to the services SWPC can render to small plants in connection with the termination of war contracts.

In the three years it has been in operation, SWPC has authorized financial assistance to small plants, in loans and machinery leases, totaling $333,091,505, Mr. Maverick said.

AUGUST REVOCATIONS OF WPB ORDERS

The following summary of revocations and changes in War Production Board orders during August 1945 was released by WPB.

Official copies of the orders themselves should be consulted for details and for any changes in the status of orders since August 31, WPB warned.

It should be noted that some orders were revoked during August after being amended earlier in the month, and therefore are listed in the Relaxation or Restrictions Section as well as in the Revocations section.

ALUMINUM—M-1-L, 8/31.—The order set up a reporting procedure for the industry whereby production and other data was forwarded to WPB. The aluminum industry is asked to continue this practice even though the order is revoked.

BUILDING MATERIALS — PR-31, 8/20.—L-157, Hand Tools Simplification; Schedule 8 to L-157, Wood Boring Bits; L-236, Hardware Simplification; and Schedule 4 to L-236, Tackle Blocks.

CONSTRUCTION MACHINERY — PR-31, 8/20.—L-192, Construction Machinery and Equipment.

ELECTRIC POWER—L-94, 8/18.—Provided for the integration and coordination of electric power system operations throughout the country and set up procedures for curtailment of power consumption.

PAPERBOARD—Amendment 1, PR-31, 8/22.—L-239, Folding and Set-up Boxes; and M-378, Paperboard.

RADIO & RADAR—PR-31, 8/20.—L-265, Electronic Equipment; L-272, Industrial Type Instruments, Control Valves and Regulators; Schedule 1 to L-272, Control Valves; Schedule 2 to L-272, Liquid Level Controllers; Schedule 3 to L-272, Pyrometers and Resistance Thermometers; Schedule 4 to L-272, Indicating Dial Pressure Gauges; Schedule 6 to L-272, Welding Equipment Gauges; and Schedule 8 to L-272, Railroad Gauges.

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300 or 500 watts, Type L-30	GEA-4304
750 or 1000 watts, Type L-31	GEA-4305
Heavy-duty, cast aluminum	
200 or 250 watts, Type L-38	GEA-4325
General purpose, sheet aluminum	
300 or 500 watts, Type L-49	GEA-4311
750 or 1000 watts, Type L-43	GEA-4310
Sports and area, sheet aluminum	
750 to 1500 watts, Type L-68	GEA-4333
Area, open porcelain enamel	
300 to 1500 watts (Type L-45)	GEA-4433
(Type L-46)	GEA-4432
Handy, sheet aluminum	
200 watts, Type L-66	GEA-4346
Underwater	
100/250/400 watts (Type L-33)	GEA-4438
500/1000/1500 watts (Type L-41)	GEA-4439

Order individually by number, or in sets, from the G-E Apparatus Sales Office or Agent that serves you. Or write General Electric Company, Schenectady 5, N. Y.

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Frankel Solderless Connectors

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STEEL—PR-31, 8/20.—L-88, Used Rail and Used Rail Joints; L-211, National Emergency Specifications for Steel Products; Schedule 9 to L-211, Oil Country Tubular Goods; Schedule 16 to L-211, Steel Wire Rope; M-17, Pig Iron; M-21-i, Malleable Iron Castings; M-24, Iron and Steel Scrap; and M-24-b, Iron and Steel Scrap.

TIN, LEAD & ZINC—PR-31, 8/20.—M-11, Slab Zinc; M-11-a, Zinc Oxide; M-65, Cadmium M-72, Lead and Tin-scrap; and M-276, Bismuth.

TOOLS—PR-31, 8/20.—E-1-b, Machine Tools; E-6, Hand Service Tools; E-10, Anti-friction Bearings; and L-302, Chain.

WAR UTILITIES—PR-31, 8/20.—L-154, Power, Steam and Water Auxiliary Equipment; Schedule 4, L-154, Power Switchgear.

CONSTRUCTION—Amendment Direction 5, L-41, 8/13.—Authorization of projects providing additional manufacturing facilities, with bottleneck priorities assistance.

ZACKMAN RESIGNS ASSOCIATION POST

Eugene P. Zachman, genial business manager of the Cincinnati Electrical Association, recently resigned his post with that group to become vice-president and sales manager of Harry Knodel Distributing Company of Cincinnati, distributors of electrical appliances.

Gene has made a host of friends during his career in the electrical industry association work. In addition to his post at the Cincinnati Electrical Association, he is president of the International Association of Electrical Leagues.

MEDICAL ASSOCIATION APPROVES FLUORESCENT LIGHTING

The American Medical Association has issued a direct answer to the apparently unfounded, though somewhat prevalent, conception that fluorescent light sources possess harmful qualities not found in other forms of artificial lighting or in daylight.

In the August 25, 1945 issue of the Journal of the American Medical Association is published the following approved statement submitted to the council on Industrial Health by the Joint Committee on Industrial Ophthamology representing the Section on Ophthamology of the American Medical Association and the American Academy of Ophthalmology and Otolaryngology:

"Fluorescent lighting has been regarded by physicians and others as possessing harmful qualities not found in other forms of artificial illumination or in daylight. Both the ultraviolet and infra-red components have been suspected

The Joint Committee on Industrial Ophthalmology, after consultation with specialists in the production and use of light, holds the following opinion:

"1. The ultraviolet energy from clear blue summer skylight is three or four times as great per footcandle as fluorescent light.

"2. Light from fluorescent lamps resembles daylight more closely than that from tungsten-filament lamps. This color resemblance to daylight is a desirable quality.

"3. Infra-red energy found in fluorescent lighting as now manufactured produces no known physiologic effect except that due to heating. Fluorescent light generates less heat per candlepower than tungsten lamps.

"4. Glare occurs in any system of lighting. Its solution rests with illuminating engineers.

"5. Individual differences occur in the level of illumination (footcandles) required to provide a satisfactory degree of visual efficiency and eye comfort. Twenty footcandles is essential for such critical tasks as reading. Higher levels of illumination are desirable for prolonged seeing, for discrimination of fine details and where low contrast prevails. These standards can be readily maintained in working places through use of properly installed fluorescent lighting.

"6. Excessive light may produce symptoms of eyestrain in susceptible individuals regardless of source. Constitutional factors should be corrected as well as the amount and kind of light.

"7. Noticeable flicker is largely eliminated in modern fluorescent installations.

"Fluorescent light is not harmful to vision. It should not cause eyestrain if properly installed and used."

A. J. SMALLEY APPOINTED PITTSBURGH LEAGUE MANAGER

The Board of Directors of the Electric League of Western Pennsylvania announce the election of A. J. Smalley as the League's manager. Mr. Smalley was formerly with the Residential Sales Department of the Duquesne Light Company, Pittsburgh.

VETERANS TO RECEIVE CREDIT FOR WAR-GAINED EXPERIENCE

A plan designed to assure every returning veteran entering industry full credit for war-gained trade skill experience is now being prepared by the Apprentice-Training Service of the War Manpower Commission.

The program now being drawn up should operate in many cases to reduce the length of required apprenticeship service of veterans entering various crafts. It is being developed by the WMC Apprentice-Training Service in cooperation

[NUMBER THREE OF A SERIES]

Standards of Merchandising

TO CREATE new and profitable markets for Electric Door Chimes, Rittenhouse has been developing new sales ideas built upon tried standards of merchandising, for its radically new door chimes soon to be announced.

▶ In association with one of the country's leading marketing research organizations, Rittenhouse devoted several months to procuring practical, up-to-the-minute sales facts for future merchandising plans. This Rittenhouse-sponsored, coast-to-coast survey among wholesalers, dealers and consumers will enable Rittenhouse to provide an array of powerful, hard-hitting, sales promotion factors designed to make Rittenhouse Chimes the fastest-selling, profit line in the country.

Rittenhouse Promotion and Merchandising Plans Include:

1. A *clearly defined* sales procedure for distributors and dealers based upon facts obtained from its national surveys.
2. Famous Norman Bel Geddes chime designs combined with new chime mechanisms *never before available.*
3. *Unexcelled tone richness,* in models to meet every consumer budget.
4. Artistic and compelling Chime Display Boards that will stop prospects on sight. *New in construction—new in display beauty and appeal—new in demonstration effectiveness.*
5. *Expertly created* full-color Window and Counter Displays.
6. Illustrated, color Dealer-Consumer Literature.
7. The largest national magazine and Sunday newspaper magazine advertising support ever put behind the sales promotion of door chimes. And it's *double-barrelled in action!* Big-circulation Sunday Newspaper Magazines for *immediate* sales volume in *heavily populated centers*—plus an imposing group of top-ranking National Magazines to tell the story of Rittenhouse superiority *to millions*—wherever they live.

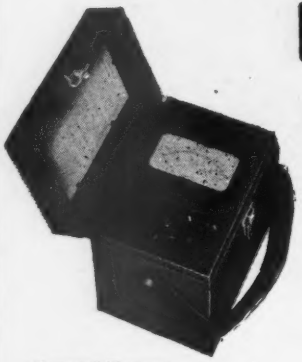
▶ These *are just a few* of the reasons why it will pay the far-sighted wholesaler and retailer *to Plan Profitably with Rittenhouse.*

Rittenhouse

The Chime with the Golden Tone

"These Bulletins sure lead me to RELIABLE INSULATION RESISTANCE TESTERS THAT SAVE A LOT OF TIME!"

VIBROTEST
INSULATION RESISTANCE TESTER



EVERYTHING the most exacting superintendent of maintenance demands in *precision and dependability* with NO tiresome hand cranking—NO leveling. Vibrotest has its own self-contained power source producing constant potential of 500 volts. Measures insulation resistance and low ohm values range to check continuity as well as resistance values of windings, armatures, etc. Durably encased. Light weight.

General Purpose
Model 201 Vibrotest
Range 0-200 meghoms at 500 volts, potential 10-2000 ohms, 150-300-600 volts, AC or DC.

Send for Bulletins for full details

Also HYPOT insulation breakdown tester, VIBROGROUND for testing ground resistance and many others. We repair electrical instruments of all makes. Wire or write

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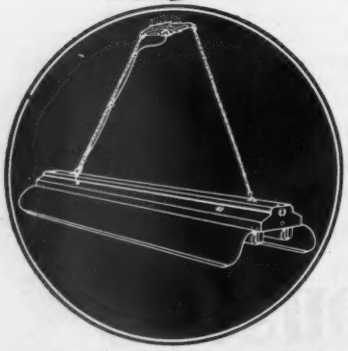
Patent No. D-141,024. *Other patents pending.* T. M's. Reg. U. S. Pat. Off.

Save dollars on
MAINTENANCE • REPAIRS • OPERATION
ON INDUSTRIAL FIXTURES



Easy and simple to install. Simply make wiring connections—screw the hanger to the outlet box—then hang the fixture. No toggle bolts or other fastening arrangements necessary.... Self grounding—2-wire cord and plug may be used. Fits on standard 4-in. or 3¼-in. outlet box or plaster ring.

$1.50 LIST PRICE

Complete with two 5-ft. chains, cord clips, "S" hooks and receptacle.
UNDERWRITERS APPROVED

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DayBrite LIGHTING FIXTURES

DAY-BRITE LIGHTING, INC.
5403 BULWER AVENUE • ST. LOUIS 7, MISSOURI

Nationally distributed through leading electrical supply houses

with management, labor and veterans organizations and will be subject to modification by State laws and trade conditions in various areas.

The basic objective, he said is to establish criteria for crediting veterans for their war trade skill experience. Because of the fact that no hard-and-fast nation-wide credit system can be established due to local limitations, the program will take the shape of a master plan that may be adapted locally by joint management-labor apprentice-training committees or individual employers.

Support of the local committees is assured by the broad sponsorship under which the program is being launched. This includes endorsement by key industry and labor leaders offered at a recent meeting of the Federal Management-Labor Committee on Apprenticeship.

The results of studies now being completed will be given the Army, Navy, Marine Corps and Coast Guard and passed on to men still in the service.

As another step to aid the returning servicemen interested in apprenticeship opportunities, the Apprentice-Training Service is preparing and will send to military separation centers and U. S. Employment Service offices a list of registered business establishments providing employment and training to apprentices.

G. L. HOCKENSMITH NAMED DIRECTOR OF WPB CONSTRUCTION BUREAU

Appointment of George L. Hockensmith as director of the War Production Board's Construction Bureau to succeed John L. Haynes was announced by Harold Boeschenstein, WPB's Operations Vice Chairman.

Mr. Hockensmith has served as deputy director of the Construction Bureau since July, 1945 and was chairman of the Construction Requirements Committee prior to that date. Before entering Government service in December, 1941, he was engaged in foundation construction work in various parts of the country. He holds a degree in engineering from the University of Maryland. His home is in Washington, D. C.

Mr. Haynes, also of Washington, D. C., served as director of the Construction Bureau from December, 1944 to the present time. He is expected to take up an assignment at the Department of Commerce in connection with the establishment of the proposed construction division of the Bureau of Foreign and Domestic Commerce.

GENERAL CONSTRUCTION FORECAST

The construction industry is primed for its role as the instrument of employment for hundreds of thousands of skilled and unskilled workers being released from the

armed services and war plants, it was declared recently by Thomas S. Holden, President of F. W. Dodge Corporation, fact-finding organization and marketing counselors for the industry.

Mr. Holden's statement was based on individual project reports from his corporation's field staff showing substantial gains in all major classifications of construction in July in the 37 states east of the Rocky Mountains, and on the release of wartime controls on industrial construction by the War Production Board.

"The industry demonstrated during the last full month of the war, even with the application of stringent controls over materials, equipment and manpower, that it is primed for its peacetime role as an instrument of wide-spread employment," Mr. Holden declared.

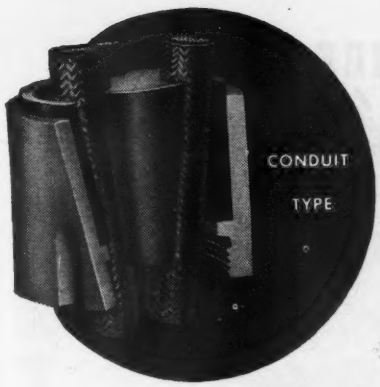
"With the removal of all controls in the next few weeks, the industry will be able to move quickly toward the attainment of an average annual volume during the next decade exceeding 13 billion dollars at March 1945 price levels.

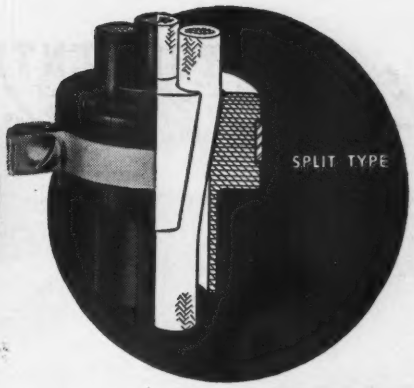
"There are reconversion problems, especially as regards manufactured articles used in construction, and some bottlenecks, such as the temporary scarcity of draftsmen, but they do not seem insurmountable to an industry which played an heroic part in supplying the nation in record time with the plants needed to win the war," Mr. Holden said.

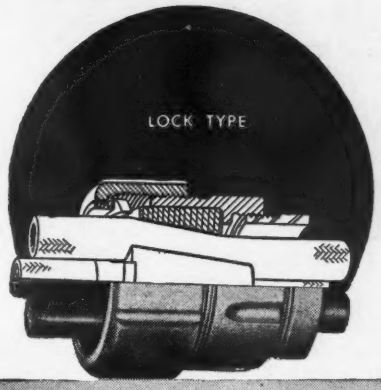
The Dodge executive pointed out that construction contracts amounting to $257,691,000 were awarded in the 37 eastern states last month, an increase of 35 percent over July of last year and 13 percent more than in June of this year.

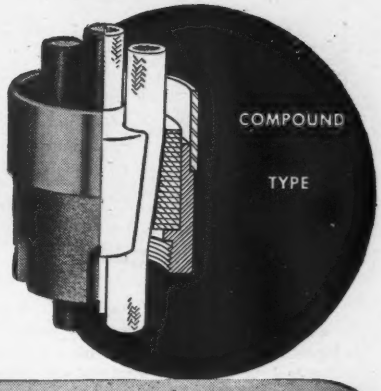
The most significant gains, Mr. Holden said, were in residential construction. For the first time this year, it registered a gain over the corresponding month of last year. The July total was $46,273,000,

Chief electrician, F. G. Koch, Ahlberg Bearing Company, Chicago, sees a big future for industrial electronics. He installed and services numerous electronic timers on radius grinders in the plant.









O.Z. CABLE SUPPORTS

CONDUIT TYPE CABLE SUPPORT for regular installations. Consists of a malleable iron body which is screwed on the conduit in place of the iron bushing and a wedging plug for gripping the cables.

SPLIT TYPE CABLE SUPPORT for use where cables are already installed. It consists of a two piece body held together by a steel band and the plug for gripping the cables.

LOCK TYPE CABLE SUPPORT for supporting cables in a conduit in any position. A locking device secures the wedging plug to insure against loosening.

COMPOUND TYPE CABLE SUPPORT consists of a regular type support fitted with an extended collar to provide a compound chamber for sealing the end of the conduit.

O. Z. ELECTRICAL PRODUCTS

- CONDUIT FITTINGS
- CABLE TERMINATORS
- CAST IRON BOXES
- SOLDERLESS CONNECTORS
- GROUNDING DEVICES
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Safe, Practical and Permanent.

Prompt deliveries from jobbers, centralized warehouses and our factory.

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an increase of 79 percent over July of last year.

The most pronounced residential gains were in single-family dwellings built for owner's occupancy, although other kinds of residential building also showed increases.

Publicly owned construction dropped precipitously in July, whereas privately owned construction rose 252 percent over the dollar volume of July 1944.

The value of all contracts awarded east of the Rockies during the first seven months of the year was $1,740,090,000, an increase of 51 percent over the corresponding period of last year, the Dodge executive announced.

INDUSTRY ADVISORY COMMITTEES TO BE RETAINED UNTIL WPB IS LIQUIDATED

Industry advisory committees of an over-all type will be retained on an "on call" basis until the War Production Board is liquidated, WPB has announced, in issuing supplementary rules to govern its advisory groups.

During the present demobilization and reconversion period, certain industry committees that represent segments of major industries will be dissolved. Over-all type committees will continue to function. As an example, WPB pointed out that the Over-all Construction Machinery Industry Advisory Committee would remain intact, but that such specific industry segments as the snow plow manufacturers' committee and concrete paver manufacturers' committee would be dissolved.

The Attorney General has assured WPB that the agency may continue to confer with industry advisory committees "until the time the present authority of the War Production Board under the Second War Powers Act, as amended, terminates."

WPB also announced that certificates of appreciation will be forwarded to 8,000 members of the 792 committees now active as well as to industry members formerly associated with the agency's advisory groups since the first one was formed late in 1941. Each certificate will express the appreciation of J. A. Krug, WPB chairman, for their "loyal service to a grateful nation."

Throughout the war, industry was invited to advise on methods of meeting requirements of the armed services and essential civilian needs, through their representative groups, in conference with Government officials. Swiftly changing aspects of the war and new international situations sometimes made it necessary for the Government to consult more frequently with business men closest to the problems of production—men who represented a cross-section of every American industry, WPB said.

Aided by the advice and information provided by such business men, WPB was able to push through vital steel manufacturing projects, provide the electronics industry with diamond dies capable of

drawing copper wires 8/10,000 of an inch in diameter, or assure manufacture of low-end textile items for war workers, WPB said.

The agency emphasized that it would continue to seek the advice of industry members whenever new plans affecting production are to be formulated or changed. WPB will continue to schedule meetings whenever any three committee members make the request and the proposed agenda concerns WPB.

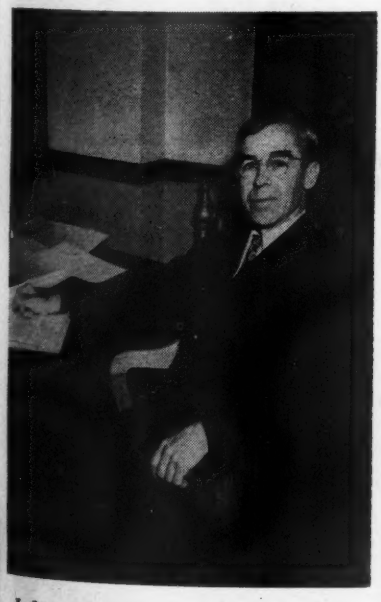
WPB division director will be designated automatically as Government presiding officers, pending formal replacement of those presiding officials who have already left the agency, WPB said.

CONSTRUCTION OPPORTUNITIES IN HOUSING

With the lifting of all wartime controls over housing construction, the housing industry faces the challenge of gearing its operations to meeting a broad and urgent need without precedent in the history of this country, National Housing Administrator John B. Blandford, Jr. declared recently.

"Serious housing shortages exist today in practically every city in the country," Mr. Blandford said. "In many areas, these shortages will become more acute during coming months as millions of veterans return to civilian life. If the housing industry will set its target at meeting the demand for new houses on a broad front, it will open up the path to a sustained volume of peak construction which will produce big outlets for jobs, production and investment during the reconversion and postwar years."

The main hazard to attaining this objective is the possibility of inflationary price increases, made possible by a demand greatly in excess of the available



Industrial oven problems are an every-day diet for P. A. Meyer, chief engineer of Young Brothers Company, Detroit. Latest addition to their line are burn-out and bake ovens for motor service shops.

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When you need Highest Quality at no extra cost insist on R&S throughout. Over 40 years of Design, Engineering and Construction experience is behind every R&S Product.

Over the years R&S has pioneered in the development and standardization of precision-built control equipment in keeping with industries' expanding requirements of new processes and codes.

A large variety of standardized explosion-proof enclosures is available for grouping and assembly of control and power units in panel form, at minimum cost and without the usual delay of special designs.

R&S Standard Enclosures have wall sections permitting a great variety of conduit arrangements and sizes to suit job requirements. This simplifies material lists and reduces inventories caused by field changes.

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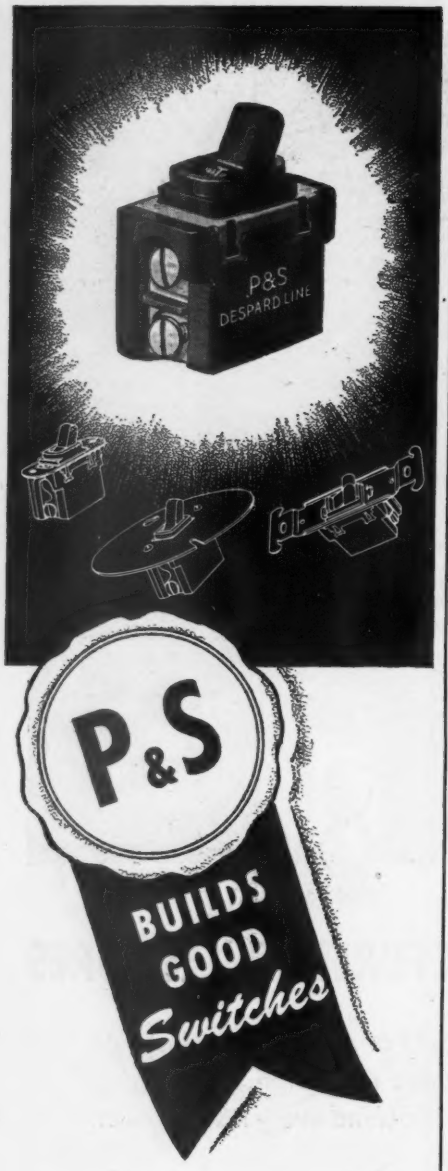

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Over fifty years experience in the design and manufacture of electrical wiring devices is your assurance that *P&S Switches are good.*

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supply which has already caused a sharp rise in the prices of existing houses in crowded areas, Mr. Blandford said.

"Unless a majority of the new houses which are produced in the next few years are within the means of average American families, there is the very real danger of a short-lived boom in home building, followed by an abrupt decline such as occurred in 1920 after the First World War," he declared.

Mr. Blandford said that the NHA would cooperate in every possible way in the six-point program announced recently by John W. Snyder, Director of War Mobilization and Reconversion, to speed expansion of the construction industry. Mr. Blandford pointed out that a substantial core of the private home building industry was kept alive during the war—that it was helped to produce more than $5,000,000,000 in war housing, largely protected by Government mortgage insurance—and that policies laid down more than a year ago are enabling it now to produce nearly 25,000 homes a month, a rate which can be stepped up as rapidly as manpower and materials become available.

"After victory in Europe, we expressed the hope that 400,000 homes could be started by next July," he said, "and reached an agreement with the War Production Board on a materials allocation for that amount of housing. We still are hoping the 400,000 units will get started and that there will be a rapid increase in production in the following year. We estimate that an average of a million and a quarter homes a year will be needed for the next 10 years to meet the needs of returning veterans, new families and those now 'doubled up' and to make substantial progress on the replacement of substandard structures.

"We believe that housing is potentially an industry providing opportunities for an annual investment of $6,000,000,000 to $7,000,000,000 and providing 4,000,000 to 4,500,000 jobs. However, it must be realized that to attain these objectives, hundreds of thousands of homes must be built for the great 'middle market' never adequately provided with new housing in the past.

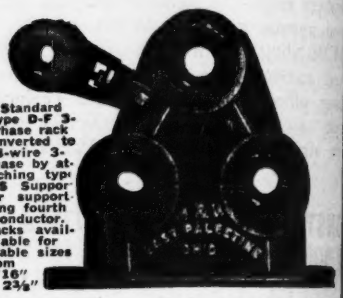
"The present vast potential market for housing, which offers a major contribution to a full employment economy in the years ahead, makes it all the more important that a full effort be made now to gear home construction to the requirements of long-term housing development. A short-lived inflationary boom now, marked by excessive prices for individual houses and an undue concentration on the luxury market, might set us back years."

Mr. Blandford called on builders, lending institutions, materials and equipment producers and labor for full cooperation in keeping housing prices on a reasonable level and in opening up the new low-priced mass market for housing which is essential to reaching and holding a peak level of construction.

"This is a time for teamwork and ingenuity to offset higher costs by increased efficiency," he said.

He pledged full cooperation by the

SIMPLICITY PLUS!
NEW NON-INDUCTIVE CABLE RACK for INDUSTRIAL PLANT WIRING



Standard Type D-F 3-Phase rack converted to 4-wire 3-phase by attaching type F-S Support for supporting fourth conductor. Racks available for Cable sizes from 5/16" to 2½"

Radically different, the new M. & W. Non-Inductive Cable Rack is designed for A.C. or D.C. systems. Racked cables only partially surrounded by metal eliminates any chance of inducted current in the rack. Impedance reduced with cables mounted in delta formation. Rack of one-piece construction . . . installation of cables made quick and easy through the use of split bearings.

Send today for Bulletin C-S-51 . . . describes these and other M. & W. items.

Hook-Mounting and Bar-Type Cable Racks • Messenger Wire and "Bull Dog" Conduit Hangers • "Bull Dog" Insulator Supports • Ground Clamps

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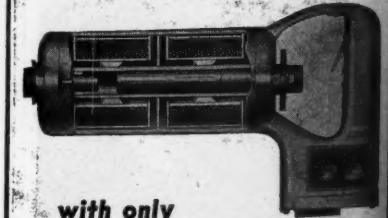

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"MK"—⅝" Cap.	$105.00
No. 18—1⅛" "	150.00
No. 22—1½" "	195.00
No. 25—2" "	225.00

SYNTRON CO. 690 Lexington Homer City, Pa.

National Housing Agency and its constituent agencies in all efforts to combat inflation in prices, to assist in the achievement of lower construction costs, and to open up broad new housing markets.

The lifting of WPB Order L-41 will not materially affect estimates of the volume of home-building possible in the next several months, Mr. Blandford explained, because the NHA had assumed in its estimates that price ceilings for new housing would be raised to $10,000 or $12,000. Plans already had been agreed upon for ending local programming and the establishment of state-wide quotas, and many regulations already had been relaxed in regard to the million housing units private builders had produced under the NHA policy of utilizing private financing for all permanent houses for war workers for which a postwar market appeared likely and which could meet war workers' needs.

"Regulations controlling war housing built with priority assistance were limited to the minimum necessary to accomplish war purposes, with the assurance that they would be lifted as soon as war conditions permitted," Mr. Blandford said. "In keeping with this policy, occupancy controls had been lifted prior to V-J Day on over 100,000 units of private war housing in areas where war needs had relaxed and were removed from all remaining private war housing immediately after the surrender of Japan. Similarly, units which were required to be held for rent during the period of the war need were released for sale as soon as they became vacant.

Carl J. Schroeder, former assistant electrical engineer for a Detroit architectural and engineering organization is now lighting engineer and western representative of Colonial Lighting Div., Colonial Neon Co., North Bergen, N. J. Carl is promoting commercial and industrial cold cathode lighting installations.

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Note how this Monarch construction prevents the fibre bar from coming in direct contact with the screw connecting renewal link to knife blade. This minimizes the charring of the fibre bar and positively prevents excessive overheating of knife blades. Note also large metal parts which dissipate heat. Result: dependable protection.
"Look No. 1" illustrates this construction in a lighter-duty Monarch knife-blade fuse and "Look No. 2" shows adaptation of this principle in a heavy-duty model.
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Specify Monarch Fuses
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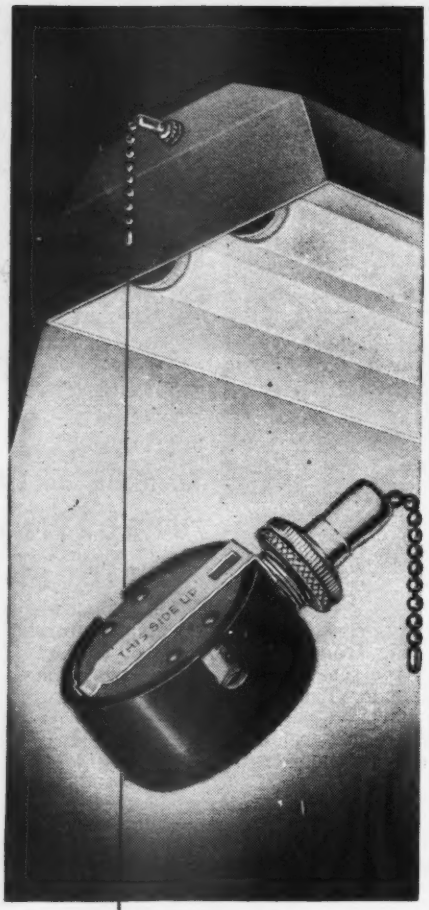

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Use them in Fluorescent installations, individual light, or F. H. motor control. They are made in 3 to 10 ampere capacity, single pole, two circuit, series multiple and three way pull. Ask your Electrical Wholesaler about Levolier Switches . . . Switch to Safety.

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Electrical Division
VALPARAISO, INDIANA

"In the Fall of 1944, when it became apparent that most of the war housing need had been met, the National Housing Agency and the War Production Board took steps to permit construction to relieve general congestion in crowded areas, to assist home building by returning veterans, and to relieve cases of individual hardship. Thus the housing industry was placed in a position to make a start on normal home building almost a year before the end of the war.

"While the scarcity of materials and manpower was a seriously limiting factor until the victory in Europe was assured, after V-E Day the authorization of priorities for these transition housing construction programs was stepped up rapidly and aimed primarily at construction in the late summer and fall building seasons. Approximately 180,000 priorities were made available.

"Although it was early in July, before the surrender of Japan, when we began to issue priorities on the basis of the allocation of materials for 400,000 houses in the next 12 months, the full effect of these priorities does not yet show in the figures on 'starts'. We are hoping that 'starts' will be much larger in September and October than the 24,000 to 25,000 rate reached in July and August.

"It is for these reasons that we are optimistic over the readiness of the housing industry to move up on its great postwar job."

CONTRACTOR RALPH JOHNSON, Sturgeon Electric Co., Denver, talks to Les Johnson, General Electric Co., Salt Lake City.

DATES AHEAD

Electrical Committee, NFPA—Stevens Hotel, Chicago, Ill., Week of October 8.
George Washington Chapter, IAEI—Board Room, District Building, Washington, D. C., October 8.
Rocky Mountain Chapter, IAEI—Room 885, City and County Building, Denver, Colo., October 9.
Virginia Chapter, IAEI—John Marshall Hotel, Richmond, Va., October 9-10.
Tacoma Division, Puget Sound Chapter IAEI—Loughlen's Cafe, 917 Pacific Ave., Tacoma, Wash., October 11
International Association of Electrical Inspectors—Western Section, LaSalle Hotel, Chicago, Ill., October 15-16; Eastern Sec-

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And Dozens of Other Applications *with the*
2200-Watt AUTOMATIC
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Why buy LESS
when you get the MOST
in AUTOMATICS
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FITTINGS
Conduit Bodies and Fittings by GEDNEY, are available for every requirement. All inclusive, this quality line features both threaded and threadless types. Underwriters Laboratories approved and distributed through recognized wholesalers exclusively. Write for catalog
GEDNEY ELECTRIC COMPANY
RKO BLDG., RADIO CITY, NEW YORK

tion, Hotel New Yorker, New York, N. Y., October 22-23; Southern Section, Baker Hotel, Dallas, Texas, October 29-31.

Long Island Chapter, IAEI—Long Island Lighting Company Auditorium, Mineola, N. Y., October 19.

National Electrical Contractors Association—Annual meeting, Hotel Carter, Cleveland, Ohio, October 29-31.

New York Chapter, IAEI—Electric & Gas Association of New York, 480 Lexington Ave., New York, N. Y., November 5.

Tacoma Division, Puget Sound Chapter IAEI—Loughlen's Cafe, 917 Pacific Ave., Tacoma, Wash., November 8.

Rocky Mountain Chapter, IAEI—Room 385, City and County Building, Denver, Colo., November 13.

North and South Carolina Chapter, NECA—Charlotte, N. C., December 5-6.

Rocky Mountain Chapter, IAEI—Room 385, City and County Building, Denver, Colo., December 11.

MANUFACTURERS NEWS

GENERAL ELECTRIC CHANGES

Harry A. Winne, vice president in charge of engineering for the General Electric Company's apparatus department, has been appointed vice president in charge of engineering policy for the entire company.

Mr. Winne becomes a member of the

H. A. WINNE

president's staff and will have headquarters in Schenectady.

Ernest E. Johnson, assistant engineer of the areonautics and marine engineering division, has been named to succeed Mr. Winne.

G. A. Beck has been appointed manager of the Industrial Design Division of G-E's Electronics Department. His headquarters will be at the Bridgeport, Conn., plant.

J. M. Lang has been named manager of the Ken-Rad Division of the G-E Electronics Department, with headquarters at Owensboro, Ky. Mr. Lang succeeds C. J. Hollatz who will make his services available in a consulting and advisory capacity for the present.

A. J. Brock has been appointed manager of the G-E Home Bureau, Bridgeport, Conn.

George H. Pfeif has been appointed

for today and for tomorrow.....

QUAD

Lighting UNITS

RLM Heavy Threaded Deep Bowl Reflector and Socket Hoods

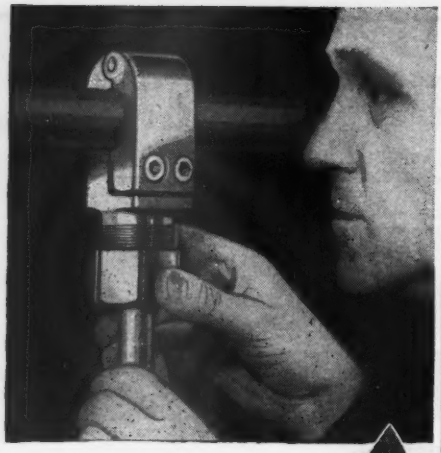
RLM Threaded Dome Reflector

OVER 53% of all jobs done by contractors involve the installation of lighting fixtures. Make your share of these jobs pay you by installing QUAD units. They are modern, easily wired and installed, quickly detachable for cleaning, and highly flexible in design. All units are weatherproof and porcelain finish is permanent. You install them and your job is finished—result is more time for more jobs. For the proper unit for general or specialized installations — indoor or out — make your selection from the very complete QUAD line.

QUADRANGLE MFG. COMPANY

Mfgrs. of Incandescent and Fluorescent Lighting Equipment

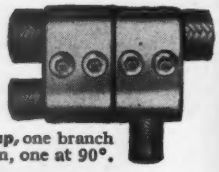
32 SO. PEORIA ST. CHICAGO, ILL.



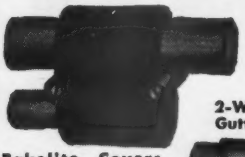
It's Easy to pick the right CABLE TAP— **from the *Complete* line**

You'll find the widest variety of parallel and 90° taps, combinations, and gutter taps — in a range of sizes up to 1,000,000 cm. Insulating Bakelite covers can be furnished for all types.

Single 90° Tap from main conductor.

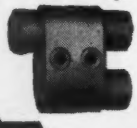


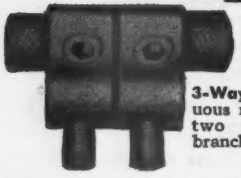
Combination Tap, one branch parallel to main, one at 90°.



Bakelite Covers can be furnished for all types of Penn-Union cable taps.

2-Way Gutter Tap.





3-Way; continuous main and two separate branches.

Also a complete line of Service Connectors, Terminals, Tees, Straight and Parallel Connectors, Grounding Connectors, etc. — every good type of conductor fitting. And every one is accurately made, thoroughly tested — *dependable.*

PENN-UNION
ELECTRIC CORPORATION
ERIE, PA.

PENN-UNION
Conductor Fittings

manager of the employee relations section of G-E's Executive Department. His headquarters will remain in Schenectady.

Four men have been named to head newly organized sections in G-E's Control Division, new name of the company's former Industrial Control Division. William M. Anthony is manager sales of the Industry Control section; Edward S. Bush is appointed manager sales of the Appliance and Aircraft Control section; S. V. W. Dockstader has been named manager sales of the General Purpose Control section, and William J. Stock is in charge of the Marketing and Promotion Section.

C. A. Lindemann has been named quality control engineer for the wiring device and accessory equipment divisions of the G-E Appliance and Merchandise Department, Bridgeport.

George Carlson has been appointed design engineer for the Conduit Products Division of the Company.

Mr. R. Wallace has been named supervisor of the commercial service section of the G-E range and water heater divisions.

ART METAL NAMES CLUM SALES MANAGER

Henry G. Clum has been appointed sales manager for The Art Metal Company of Cleveland. Associated with the Jersey Central Power and Light Company for 16 years, Mr. Clum began as

H. G. CLUM

a lighting specialist at Morristown, N. J. and was promoted to manager of the lighting department in charge of design and promotion of all phases of lighting application. He also conceived and carried out a program for the standardization of street lighting equipment.

WESTINGHOUSE APPOINTMENTS

James A. Baubie has been appointed director of the Public Relations Department of the Westinghouse Electric Corporation. Since November, 1943, Mr. Baubie has been assistant manager of the

DEPENDABLE
CHICAGO
ANCHORING UNITS
HOLD!

Here's the dependable anchoring unit for use with machine bolts. Each 2-unit set consist of 4 pieces—two of malleable iron and two of lead—to insure maximum holding power. Furnished plain and threaded in 6 sizes for 3/8" to 1" bolts. With Chicago Anchoring Units, holding power equal to the tensile strength of the bolt being anchored can be obtained by using additional units.

IMMEDIATE DELIVERIES

on these and other Chicago Anchoring devices. Write for Catalog.

CHICAGO
CHICAGO EXPANSION BOLT COMPANY
2231 W. Ogden Ave. • Chicago 12, Ill.

HEAVY DUTY
Carbon Lamps

FOR INDUSTRIAL USE

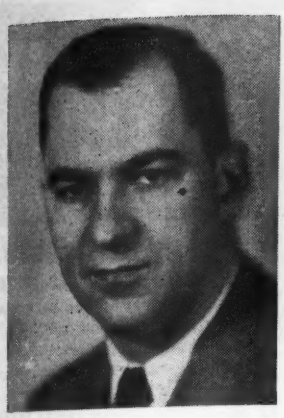
• Recommended for use where *Long Life* is essential, where *Vibration* is excessive, where *Inaccessibility* of lighting fixtures makes *Replacement Difficult*, where a *Pilot Light* is needed.

Available in a wide variety of sizes, shapes, candle power and voltages—standard and candelabra bases.

A large supply of all standard types are carried in stock, thus assuring you prompt service at all times. Write for catalog sheet 1-2 for full details or see your Electrical Wholesaler.

NAELCO

NORTH AMERICAN ELECTRIC LAMP CO.
1044 Tyler Street, St. Louis 6, Missouri



A. C. MONTEITH

Public Relations Department. He now assumes the responsibilities which were formerly under the direction of G. Edward Pendray, assistant to president. Mr. Pendray has resigned to open offices in New York as a counsel in public relations.

The appointment of A. C. Monteith as assistant manager of Headquarters Engineering has been announced. Manager of the Industry Engineering Department since 1941, Mr. Monteith will direct headquarters engineering activities in the absence of C. A. Powel, assigned to the military government of Germany with responsibility for establishing the control of electrical and radio manufacturing in that country.

At the same time, Mr. Monteith was named director of education. In this capacity Mr. Monteith assumes over-all responsibility for student recruitment and training, university relations including university visitation, scholarships, fellowships, and professorships. These activities will be directly supervised by Charles W. MacLean, whose appointment as manager of the Educational Department was also announced.

Lloyd A. Russ has been named manager of the Agency and Specialties Department. He succeeds W. D. Turnbull, who resigned.

Edgar W. Bartz, formerly of East Pittsburgh and Trafford, Pa. has been appointed welding specialist for the San Francisco Bay area.

Frank C. Cline, special representative for the Westinghouse Lamp Division in its Northwestern District headquarters at Chicago, has been appointed acting manager of the Southwestern District with headquarters at St. Louis, Mo.

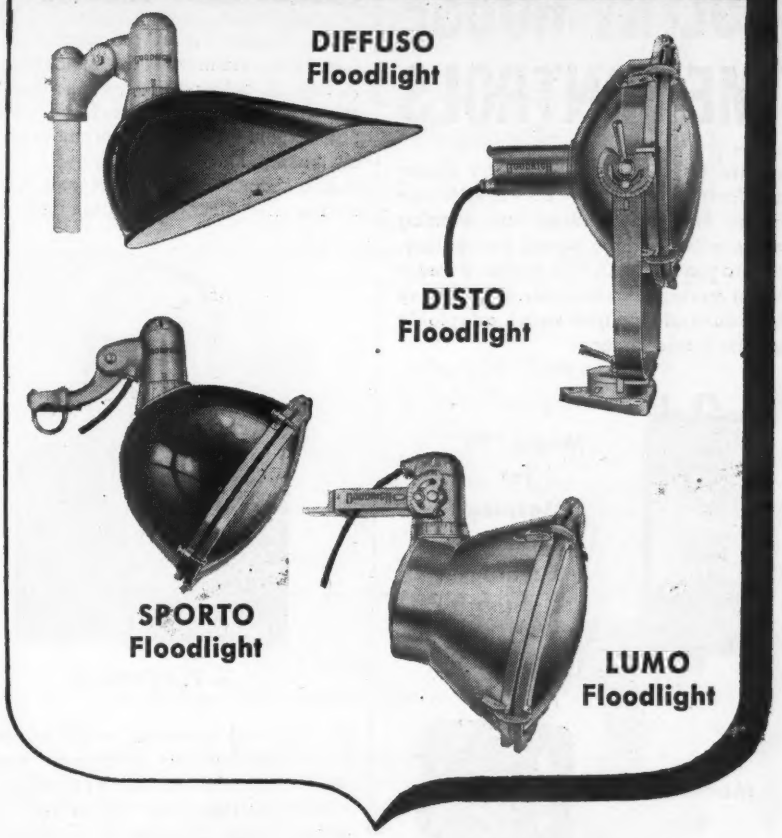
George S. Crawford has been appointed to succeed Mr. Cline as special representative in Chicago.

Charles H. Atkin has been appointed supervisor of employment and training for the Westinghouse Lamp Division.

FAIRBANKS MORSE SALES EXECUTIVE CHANGES

Two changes in the sales executive organization of Fairbanks, Morse & Co. have been announced. New acting manager of the Railroad Division is John

AS PROMISED for Postwar—



New and Improved
GOODRICH FLOODLIGHTS

For the past two years, Goodrich engineers have been developing these and other new floodlights as promised—improving design and construction—devising better finishes, increasing illuminating efficiencies.

Now they're ready . . . going into production to bring you the most advanced features known in floodlighting equipment today. Here are new mechanical advantages which mean easier wiring, easier installation, easier servicing. And here is dependable Goodrich quality to protect your investment.

Whatever your floodlighting needs —for industrial, business or recreational areas—Goodrich offers a size and style to meet each specific requirement for intensity of illumination, area to be illuminated, type of mounting, etc. Various styles are available in permanent porcelain enamel or Alzak aluminum finishes. Ask Goodrich to recommend the styles best suited for your needs.

Sold Through Electrical Wholesalers

GOODRICH
ELECTRIC COMPANY
4600 BELLE PLAINE AVENUE, CHICAGO 41, ILLINOIS

Mr. Tops, the Paragon symbol of top quality.

TOP QUALITY

POULTRY HOUSE TIME CONTROLS

Here are two first quality Poultry House Time Controls. Paragon "PS" models are designed for both morning and evening lighting, with dimming period for roosting. The Paragon Model 301 is designed essentially for morning lighting only. It is a heavy duty, industrial type time switch adaptable to poultry house lighting.

Model "PS" for Morning and Evening Lighting

Model 301 for Morning Lighting Only

Send for Authoritative Bulletin

Paragon has prepared a 4-page, 2 color bulletin containing authoritative information relative to poultry house lighting control. It summarizes the recommendations of leading poultry authorities and gives complete data regarding the wide range of Paragon poultry house time switches. Send for a supply to distribute among your dealers and power companies.

PARAGON ELECTRIC COMPANY
710 Old Colony Building • Chicago 5, Illinois

Paragon Chicago
BUILDERS OF ELECTRICAL EQUIPMENT SINCE 1905

S. King, formerly manager of the Pump Division. He succeeds C. H. Wilson.

Arnold G. Brown, formerly assistant manager of the Pump Division, succeeeds Mr. King as manager of that division.

L. A. Harlow has been named manager of the Advertising Department. He has been assistant advertising manager since 1943.

MASTER VIBRATOR NAMES STANTON SALES DIRECTOR

The Master Vibrator Company of Dayton, Ohio, announces the appointment of Arthur T. Stanton as general sales director with supervision over all domestic and export sales, sales promotion, merchandising and advertising.

Mr. Stanton, former director of sales of the Chrysler Corporation and a mechanical and industrial engineer, returns to private industry after four years in Washington, where he was called from Willys-Overland, to help Floyd Odlum organize the Division of Contract Distribution. More recently he served as chief of operations in WPB's Production Facilities Bureau.

A. T. STANTON

WESCO APPOINTMENTS

W. E. Knapp, Jr. has been appointed branch manager of the Westinghouse Electric Supply Company's Fort Worth house, succeeding E. C. Cummins, who resigned.

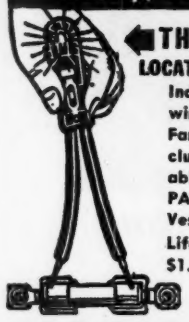
Appointment of J. B. Trescott to the Westinghouse Electric Supply Company headquarters organization as St. Louis Rural Electrification Authority representative has been announced.

WATCO ENGINEERING APPOINTMENTS

Watco Engineering, Inc. of Cleveland, Ohio announces the appointment of the following representatives as manufacturer's agents—

Test-O-Lite

TESTS ANY VOLTAGE... 100 to 550 Volts, A.C. or D.C. —Safely, Swiftly, Surely



THE NEON GLOW LOCATES TROUBLE INSTANTLY

Indicates hot or grounded wires. Tells AC to DC. Far superior to ordinary clumsy test bulb. Indispensable in shop or home. Has PATENTED safety features. Vest pocket size.

Life time guarantee. List $1.50. Purchase thru electrical dealers. Pat. #1,778,883.

For Quick Soldering

A small quantity applied to the joints to be soldered will, WHEN HEATED, flow and unite the parts the same as wire and bar solder No flux or soldering iron required. (Priority A-7 or better) 25c tubes; 1, 5, 10 and 25-lb. cans.

L. S. BRACH Mfg. Corp.
55-63 Dickerson St. Newark, N. J.

SOLAR Electrical Products

Quotation on request

SOLAR ELECTRIC CORPORATION
WARREN, PENNSYLVANIA

H. J. Brooks will cover the state of Pennsylvania, exclusive of Pittsburgh, Maryland, Washington, D. C., and New Jersey south of and including Asbury Park.

William B. Terry in Western Missouri from and including Springfield West, Kansas, Iowa, Nebraska, Arkansas and Oklahoma.

R. E. Zannoth covers the state of Michigan.

B. H. Schwartz in Virginia, West Virginia, North and South Carolina, and Tennessee.

C. W. McDaniel will be responsible for California, Oregon and Washington.

A. W. Schmoldt will cover Ohio and Indiana.

CUSACK NAMED DIRECTOR OF SALES OF HALL LAMP CO.

The appointment of Thomas P. Cusack, Jr., as director of sales development has been announced by the C. M. Hall Lamp Co. of Detroit. Mr. Cusack, until his new appointment, has been head of

T. P. CUSACK, JR.

the Hall infra-red heating division. He will continue to devote considerable time to the infra-red division and to counselling industry on production heating problems.

•

American Central Manufacturing Corporation, Connersville, Ind., has named Kenneth Cook as sales training manager. In his new responsibility, Mr. Cook will head up an intensive course in kitchen equipment planning which American Central is preparing for its distributors and dealer representatives.

•

Square D. Company announces the appointment of Walter H. Bodle as assistant to the merchandise sales manager with headquarters at Detroit. Mr. Bodle joined Square D in 1934 as manager of the company's Indianapolis office and in 1937 came to Detroit for sales promotional activities. In 1943 he opened and

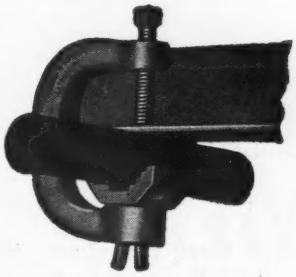
FULLMAN Latrobe PRODUCTS

FLOOR BOXES · WIRING SPECIALTIES

FULLMAN MANUFACTURING CO. QUALITY LATROBE SUPREMACY LATROBE, PA.

Peace Brings Increased Demand for Latrobe Products

Latrobe Products developed in peace time served with distinction throughout the long war years and now again in peace the demand for them becomes ever greater.



No. 470 "Latrobe" Pipe or Conduit Hanger

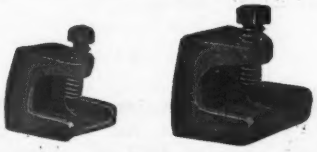
For hanging pipe or conduit to steel beams where firm, sure grip is essential. Takes pipe ½", ¾", and 1".

No. 284 Nozzle with No. 200 Cover Plate

A Duplex Receptacle Nozzle that looks neat and can be depended upon for long service. Furnished with ½" or ¾" brass pipe extension.

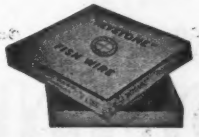
No. 150 Box with No. 207 Nozzle

Right for installation in concrete or in wood finished concrete floors. Yes, it has underwriters approval.



"Bull Dog" Insulator Supports

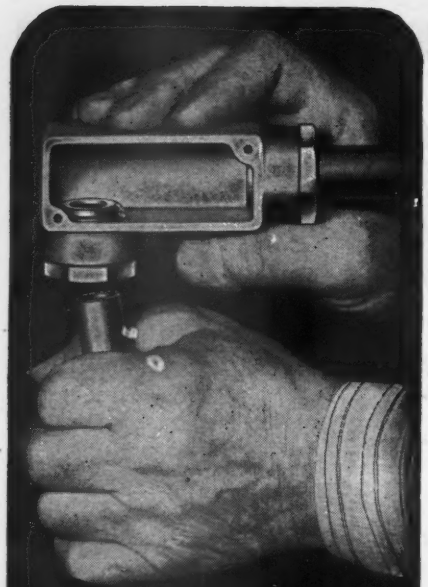
For fastening porcelain or glass insulators to exposed steel framework.



Keystone Fish Wire

Finest grade flat steel wire. Ten sizes. Coils from 100 ft. up.

FULLMAN MANUFACTURING CO.
LATROBE . . . PENNSYLVANIA



You can use THIN-WALL Tubing—

—at ANY outlet of ANY Kondu fitting.

Just slip out one bushing and slip in another. No extra pieces are needed.

Every Kondu box is a union, and can be taken out of the line without disturbing conduit.

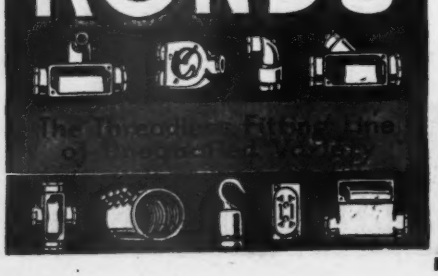
Practically unbreakable, Kondu fittings are 100% re-usable. Self-aligning . . . vibration-proof.

Write for the Kondu catalog.

KONDU CORPORATION
Erie, Pa.

KONDU MFG. CO. LTD., Preston, Ontario

KONDU



managed the Square D manufacturing and assembly plant at Seattle, Wash.

Ernest R. Walton has succeeded Mr. Bodle at Seattle.

•

Harry M. Francis has returned to the **American Steel & Wire Co.,** U. S. Steel subsidiary, to resume his duties as assistant vice president, sales, following a three year period of service with the War Production Board in Washington.

Emil C. Ostlund has been appointed chief industrial engineer. He succeeds Cecil W. Guyatt, recently named assistant to the chairman of operating committees, United States Steel Corp. of Delaware.

•

Allis Chalmers Mfg. Co. announces the appointment of J. Warren Roberts as branch manager of the Chattanooga office.

•

All-Steel Equipment Company of Aurora, Ill. has named Ralph H. Hinchman as sales manager of the Etiel Division. He has been with All-Steel for 20 years as assistant sales manager.

•

Sylvania Electric Products, Inc., has named Fred B. Parker as assistant sales promotion manager. Formerly sales representative for the company in Florida, Mr. Parker has been with Sylvania Electric since November 1944.

•

Donald L. Chaffee has joined the Sales Engineering Department of the **Copperweld Steel Company** of Glassport, Pa. He has been with the Wire Branch of the Signal Corps Engineering Laboratories, Camp Coles, N. J.

•

The Lincoln Electric Company has opened a new direct factory branch sales office in St. Louis. The new branch, under the direction of B. J. Brugge as welding engineer and district manager of sales and service, is located at 4427 Manchester Avenue.

•

Robert Hetherington & Son, Inc. of Sharon Hill, Pa. has opened a West Coast office at 5607 W. Adams Blvd., Los Angeles, Calif.

Sales in the West Coast area will be under the direction of C. E. Fisher, who for 15 years was connected with the Glenn L. Martin Company, Baltimore, Md., but who for the past year has been actively engaged in sales work on the West Coast.

Engineering on the West Coast will be under the direction of L. E. Massie, operating from the same office.

Revere

CONVERTIBLE SERVICE STATION ISLAND LIGHT

STRONG
STURDY
WEATHER-PROOF
EASILY WIRED
VERSATILE
EFFICIENT

Available in Alzak Aluminum or colored Porcelain Enamel. Color scheme of station can be maintained.

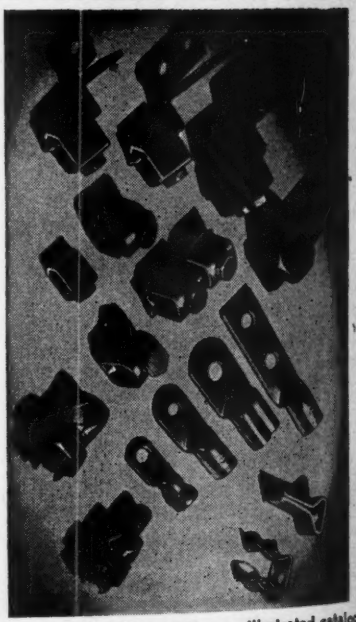
OUTCLASSES THEM ALL!

This floodlight serves the double purpose of illuminating service station pump islands as well as spotlighting the station . . . a REVERE creation that offers outstanding possibilities.

The REVERE Line comprises a complete array of distinctive units specially engineered to do a thorough lighting job. Write for Catalog data

REVERE ELECTRIC MFG. CO.
6017 Broadway — Chicago 10 Ill.
Indoor and Outdoor Lighting of Every Description

ILSCO
Electrical Connectors



Please send details and 48-page illustrated catalog

Name.....

Firm Name.....

Address.....

ILSCO COPPER TUBE & PRODUCTS, Inc.
CINCINNATI, OHIO

Graybar Electric Company, Inc., has named H. M. Nazor as manager of its Akron, Ohio Branch. He began his career with the company in 1936 at Louisville and moved to Cincinnati in 1940 where he remained until now.

K. B. Mayer until recently manager at Akron has been transferred to Chicago where he will supervise Rural Lines Department activities.

•

Faraday Electric Corporation of Chicago announces the election of K. K. Gordon as vice president in charge of sales. For the past two years he has been Eastern district manager. Mr. Gordon succeeds Paul H. Hill, who resigned to join Shick, Inc. of Stamford, Conn.

•

Elastic Stop Nut Corporation of America, Union, N. J. has named O. M. Hullinger as manager of the Chicago Office with headquarters at 20 North Wacker Drive. Mr. Hullinger came to the Esna Corporation from the Line Material Company, where he was manager of transformer sales.

•

Aircraft-Marine Products, Inc. of Harrisburg, Pa. have opened export offices at 612 N. Michigan Ave., Chicago 11, Ill. E. G. Hefter, who has been mid western sales manager for the past four years is manager of this office.

•

Fred J. Button has joined the sales organization of **The Trumbull Electric Manufacturing Co.** of Plainville, Conn., and will be located in their Detroit district office.

•

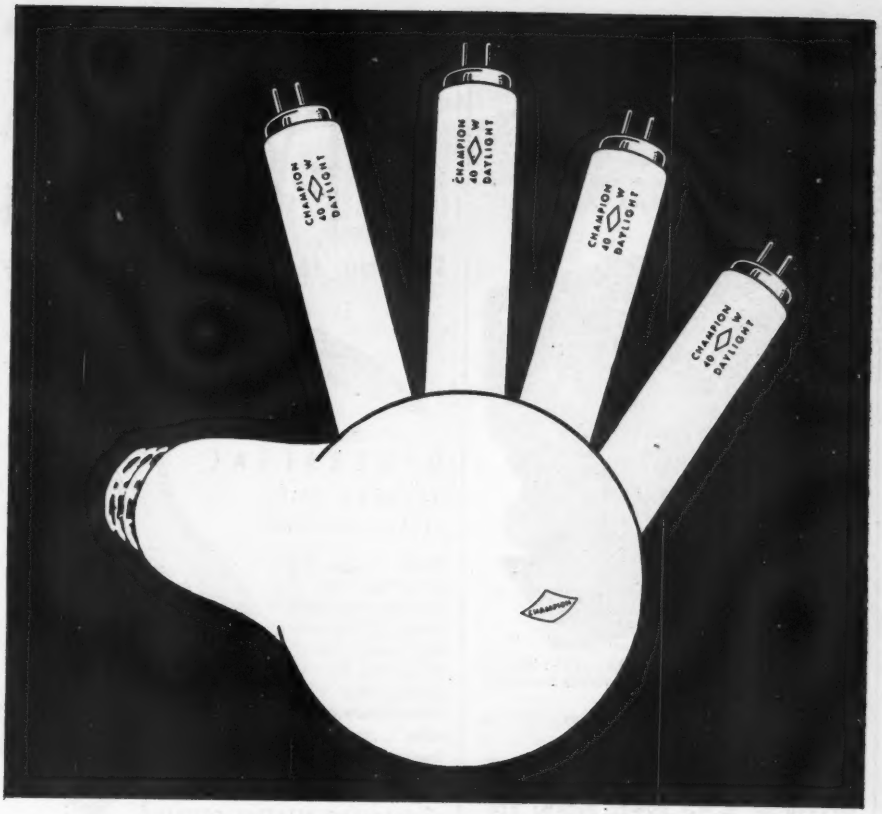
American Transformer Company of Newark, N. J. has appointed George G. Felt as advertising and sales promotion manager.

•

Paul Henry Company of Los Angeles, Calif. announces the appointment of Albert E. Baak as executive director of its Controls Division. Mr. Baak has been associated with the Minneapolis-Honeywell Regulator Company for the past twelve years.

•

General Luminescent Corporation of Chicago has moved into a new plant at 732 South Federal Street.



You get FIVE Big Opportunities to Better Plant, Product and Profits when You Call in the CHAMPION Lighting Engineers

The makers of CHAMPION **Fluorescent** and *Incandescent* Lamps offer you a complete and unbiased consulting engineering service on industrial and office lighting *without charge or obligation.*

As one of the largest and longest established producers of fine quality lamps, we present this service in recognition of the importance of *good industrial lighting* on these five counts:

1. **Quality of Production**—more accurate work, better inspection and supervision
2. **Quantity of Production**—increased working efficiency sustained over longer periods
3. **Economy of Production**—greatly reduced spoilage and better use of space
4. **Improved Health and Safety** — reduced eyestrain, conserved nervous energy, sharply diminished accident hazards
5. **Improved Morale** — better seeing eliminates strain, makes work more pleasant as well as more efficient, decreases labor turnover

For competent counsel on how to secure any or all of these five benefits from better lighting, get in touch with

CHAMPION LAMP WORKS

Lynn, Massachusetts

A DIVISION OF CONSOLIDATED ELECTRIC LAMP CO.

110-Volts A. C. from Direct Current

with KATOLIGHT ROTARY KONVERTERS Change 32, 110 or 220 volts D.C. to standard 110-volt, 60-cycle A.C. for operating radios, electronic & sound apparatus, electric signs, A.C. appliances, etc.

KATO ROTARY KONVERTER, 225 Watts
Pioneers in the Building of Small Rotary Converters

Special motors and generators 25 to 800 cycles.

Also manufacturers of A.C. and D.C. generators ranging from 350 watts through 25 K.W.; power plants; Frequency Changers; and Motor Generator Sets.

KATO ENGINEERING CO.

648 N. Front St., Mankato, Minnesota

Millions of Steel

JIFFY CLIPS

Serving the Electrical Industry

Specify
MINERALLAC
HANGERS, CLIPS,
STRAPS, BUSHINGS

Expert design, choice materials and controlled manufacture have built "top-service and longest life" into Minerallac Electrical Specialties. That's why the electrical industry "prefers Minerallac"... in steel and Everdur for hanging pipe, conduit, BX cable, etc.

Send for new literature and prices.

MINERALLAC ELECTRIC COMPANY
25 North Peoria Street—Chicago 7, Illinois

MINERALLAC

Cost Of Doing Business

[FROM PAGE 96]

plans to retain a position of leadership in the appliance business in his trade area. He knows also that there will be new and aggressive competition. So he plans to increase his service facilities and thereby outdistance competition on that score—giving him a big selling advantage and a permanent business builder.

With the exception of rent, heat, depreciation and possibly insurance, all overhead items are adjustable. Being set on a percentage of volume, they can rise or fall in relation to actual sales volume, so he is playing safe. His books show him *every month* how his expenses and margins are running in relation to sales volume, and necessary adjustments can be made in a reasonably safe time. *Let me emphasize the vital importance of monthly statements which show the true condition of your business in relation to your sales quota and expense budget.*

This dealer's percentages allotted to each item are safe figures, being based on his own past records for 16 years of war and peace, boom and depression. He plans to spend more than $3,000 on new business fixtures and equipment to meet postwar competition in his community. Knowledge begets confidence and confidence begets success.

Profit Margins

Now all of this discussion would be wasted time, if each of you could not fit whatever seems appropriate into your own postwar business hopes and plans. So the blank spaces in Table II are for your own use. You will find it interesting, important and profitable to work out your own figures alongside of the others. Let me caution you, however, that the total overhead figures in the two tables are below the national averages for the appliance business. The 1943 Hardware Dealers Survey shows even lower figures.

Some of you may question the average realized margin of only 30.3 percent shown by the 12-year history of one dealer's business. That margin closely parallels the record in the hardware business, and the dealer whose figures we are using, had some sidelines which could be found in hardware stores. It is important to understand that in this case, as in all others where we seek facts, it is not the discount you get or the profit you hope

Now . . .
the basic principles of electric circuits applying to all fields of specialization—
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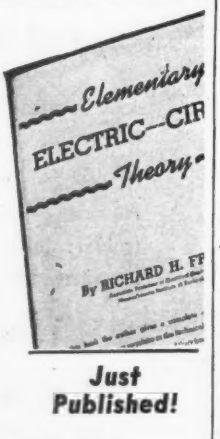

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CONTENTS

1. Electric-circuit Definitions and Concepts
2. Resistance Networks
3. Basic Alternating-Current Concepts
4. Use of Complex Algebra
5. Impedance Networks
6. Nonsinusoidal Waves
7. Polyphase Networks
8. Transients

Appendix: Tables and Charts
Wire Tables
Skin-effect Ratios
Current Capacities
Physical Capacities
Trigonometric Functions
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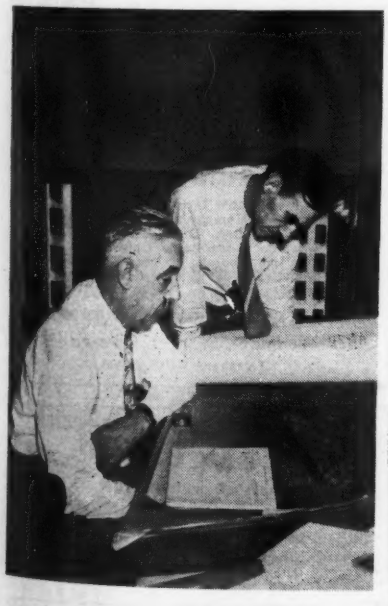
to make that counts, but how much did you actually realize or can you expect to realize after you have cleared up all adjustments, necessary markdowns on demonstration models, closeout of white elephants, etc. You will get stuck occasionally with a bad bargain that cuts into your over-all margin. Then don't forget those "hot shot" specials which come in a normal competitive market—the low-end refrigerators, washing machines, radios and other appliances which carry margins of only 30 percent or less.

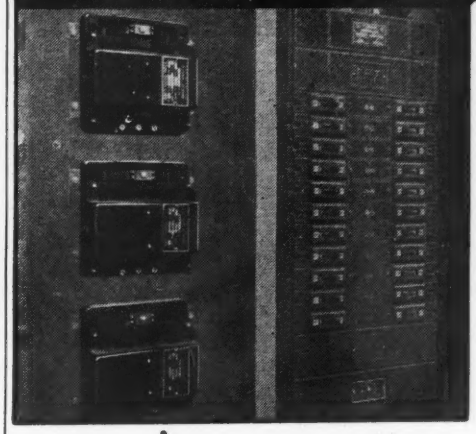
If you have thought in terms of 40 percent or greater average margins, it may be a shock to realize that it will be safer to expect only 33⅓ percent in the future. If you expect an average margin of 40 percent and budget your expenses accordingly, you will be sorely disappointed if your expenses total 36 percent and your actual margin turns out to be only 33⅓ percent. I shall not attempt to forecast what your margins or discounts on postwar appliances will be, but an increase would be surprising. In setting up your sales quotas, remember to give extra attention to the top quality lines, which pay better margins, to offset the low discount lines.

This is a challenging business and I expect the figures I have presented here to be challenged from many angles. We are all eager to know more, and by passing information around we all benefit. We need that sort of thing more than ever in this fearfully great postwar era that lies before us.



Three brothers comprise the Long Electric Company, Detroit electrical contractors. Shown here studying a new layout are (L to R) B. M. and W. S. Long. The third brother, C. S. Long, is the field supervisor for their various projects.

4 REASONS
FOR REMOTE CONTROL OF POWER AND LIGHT



1 Simplicity and flexibility in the design of electrical distribution systems.

2 Convenience in control, eliminating waste current as well as loss of time in turning on and off widely separated individual circuit switches.

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4 FEATURES
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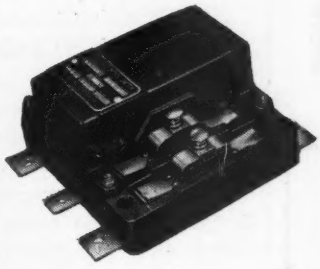

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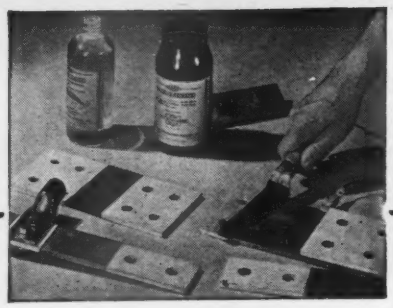

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High Voltage Distribution Builds Transport Planes

[FROM PAGE 93]

bus duct feeders. The flexibility of bus duct which permits outlets to be located where needed is invaluable in converting production from one type plane to another, involving machine layout changes, and similar changes in power requirements, according to E. P. Reixinger, Division plant engineer.

Power is distributed to motors and equipment and to lighting circuits through rigid conduit and rubber covered wires.

High bay areas in the plant are lighted to an approximate 25 footcandles by individual two-lamp 85 watt RF fluorescent units. A total of 5406 such units are installed. Fig. 3, showing a general view of the plant, shows some of these RF units. Low bay areas are lighted with two-lamp and three-lamp continuous row 40 watt fluorescent units, and provide an average intensity of 25 footcandles. There are 33,746 40-watt lamps used, with approximately 95 percent of these lamps in two-lamp reflectors. Paint spray booths are fluorescent lighted. Here the units are explosion-proof, using compressed air in the unit to achieve the explosion-proof feature.

The assembly section of the plant is equipped with four-service trench receptacles. These receptacles are located on 25-foot centers (Fig. 10 for trench receptacle layout), and furnish four types of power as follows:

1. Hy-cycle, 180 and 360 cycle
2. 120 volt 60 cycle
3. 440 volt 60 cycle
4. 250 volt d-c

Motor-generator sets are used in conveniently located distribution centers to produce hy-cycle and direct current power. Power for these motor-generator sets is taken from the 440 volt 3-phase bus duct system.

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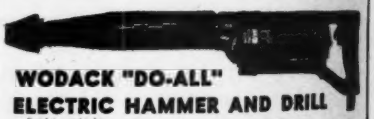

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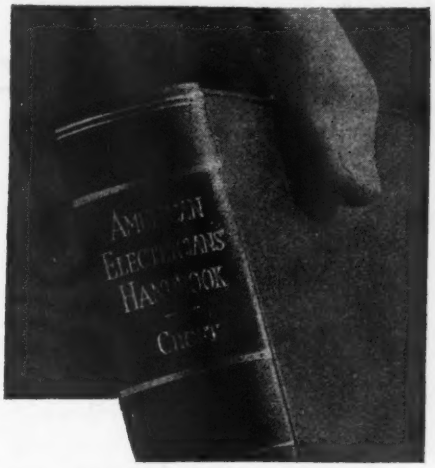

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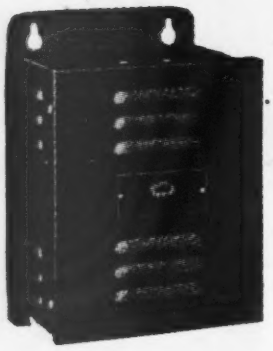

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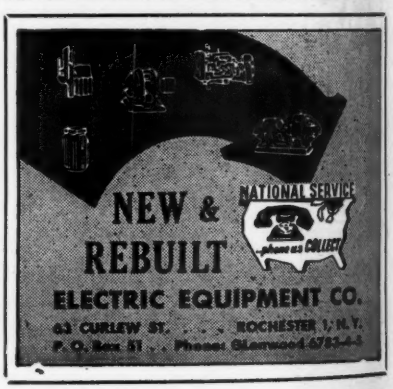

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Qu.	Kva.	Voltage	Cycles	Taps	Phase
1	2750	11000—393	60		3
3	1500	22000—6600	60	4–2½	3
5	1000	14520—2300	60	4–2½	1
		Scott taps on primary			
1	750	6600—4000 Auto	25		3
1	700	6600Y—2300	60	4–2½	3
6	700	44000—2400	60	4–2½	1
4	600	6600Y—2300	60	2–5	3
3	500	6900/11950Y—230/460	25	4–2½	1
2	500	2300—115/230	60	4–2½	1
3	500	11000—2300	60	4–2½	1
3	500	44000/22000—2300	60		1
3	500	11000—2300	60		1
1	400	6600Y—2300	60	2–5	3
2	400	6600Y—2300	60	3–4½	3
1	375	6600—440	25	6–4½	1
3	300	33000—2300	60	3–5	1
2	250	5500—575	60		1
		Scott two ph. high volt three ph. low volt			
3	200	6600—600	60	2–5	1
1	200	5500—575	60	2–5	1
1	200	2300—230/460	60	2–5	1
1	150	2400—120/240	60	2–5	1
1	125	2300—575	60		1
2	125	2200—575	60		1
3	100	12480—2416/604	60		1
1	100	13200—125/250 Scott	60		3–2
3	100	13200—2300	60	2–5	1
3	100	13800—115/230	60	4–2½	1
1	100	6600—4.00	25		1
3	100	13200—2300	60	2–5	1

Qu.	Kva.	Voltage	Cycles	Taps	Phase
1	100	13200/6600—220/440	60	2–5	1
1	100	13800—230/460	60	2–5	1
2	100	6600—2400	60	2–5	1
1	100	23000—230/460	60	2–5	1
1	100	2200—575	60		1
3	75	11500—575	60		1
1	50	11000—2300/4600	25	2–5	1
1	50	6900—230/460	25	3–4½	1
2	50	2200—575	60		1
3	50	11500—575	60		1
1	50	12480—2400	60	taps above & below	1
2	50	12000/24000/48000—2300	60	2–5	1
2	50	24000—12000	60	2–5	1
2	50	13800—120/240	60		1
1	50	22000/11000—2300/4600	60		1
1	50	2300—220/440	60	2–5	1
1	50	6900—230/460	60	2–5	1
3	50	13200—2400	60	4–2½	1
3	50	2300—575	60	3	3
1	50	13200/2200—600	60		1
1	40	2300—115/230 subway	60	2–5	1
1	30	2300—115/230	60		1
1	30	2300—230	60		3
2	25	2300—575	60		3
2	25	33000—2300	60	4–2½	1
1	25	11500—115/230	60	2–5	1
1	25	2200/4400—220/440	60		1
5	25	13800—2300/4600	60	2–5	1
4	25	2300—115/230	60		1
6	25	2300—575	60		3
1	25	11000—2200	60		1

Qu.	Kva.	Voltage	Cycles	Taps	Phase
1	25	2300—115/230	60		1
1	25	6600—2200	60		1
1	25	11000—2200	60	2–5	1
1	25	11000—2200	60		1
1	22½	4157—480/240 Y Pri. Delta Sec.	60		3
2	20	2200—575	60		1
3	20	2300—115/230	60		1
3	15	13200—2300	60	2–5	1
2	15	6600—240/480	60	3–4½	1
1	15	11500—4600/2300	25	2–5	1
1	15	2400—120/240 Subway	60		1
1	15	2400—120/240	60		1
1	15	11500—2300/4600	25		1
2	15	2300—230	60		3
1	15	13800—230/115	60		1
1	15	6600/13200—120/220	60		1
1	15	2200—575	60		1
1	10	4600—230/460	60	2–5	3
1	10	13200—2300	60		1
1	10	13200—230	60		1
2	10	11500—2300/4600	60	2–5	1
1	10	13800—575	60		1
1	10	13800—115/230/460	60		1
1	10	13800—115/230	60		1
1	10	2300—575	60	2–5	1
1	7½	2300—115/230	25		1
1	7½	2300—6.6 amp. RO St. Ltr.	60		1
1	5	6600—120	60		1

REBUILT TRANSFORMERS

Qu.	
16	1 KVA, 2400-120/240 Voltage
2	1 KVA, 2200-122/244 Voltage
1	1 KVA, 2300-230/460 Voltage
1	1 KVA, 2400/4800-120/240 Voltage
1	1 KVA, 1100/2200-110/220 Voltage
14	1½ KVA, 2400-120/240 Voltage
1	1½ KVA, 460-115 Voltage
1	1½ KVA, 2300/4160Y-600 Voltage
120	1½ KVA, 4800-120/240 Voltage
15	2 KVA, 2400-120/240 Voltage
1	2 KVA, 3300-122/244 Voltage
2	3 KVA, 2300-575 Voltage
1	3 KVA, 550-110/220 Voltage
6	3 KVA, 460-115/230 Voltage
1	3 KVA, 600-120/240 Voltage
1	3 KVA, 2300-230/460 Voltage
1	3 KVA, 550-220 30 dry Voltage
1	4 KVA, 2300-115/230 Voltage
17	5 KVA, 2400-120/240 Voltage
1	5 KVA, 4800-120/240 Voltage

Qu.	
1	5 KVA, 2080/1040-575/237½ Voltage
1	5 KVA, 2200-575/237½ Voltage
1	5 KVA, 4600-115/230 Voltage
1	5 KVA, 2200-122/244 Voltage
1	5 KVA, 3300-122/244 Voltage
1	5 KVA, 2200-575 Voltage
1	5 KVA, 600-120/240 Voltage
5	7½ KVA, 2400-120/240 Voltage
2	7½ KVA, 6900-230/460 Voltage
1	7½ KVA, 2400/4800-120/240 Voltage
1	7½ KVA, 2400-600 Voltage
1	7½ KVA, 2300-575 Voltage
12	10 KVA, 2400-120/240 Voltage
1	10 KVA, 2300-230 Voltage
1	10 KVA, 2300-575 Voltage
2	10 KVA, 2400-600 Voltage
1	10 KVA, 4600-115/230 Voltage
18	15 KVA, 2400-120/240 Voltage
1	15 KVA, 2400/4800-120/240 Voltage
3	15 KVA, 2400-600 Voltage

Qu.	
1	15 KVA, 13800-115/230 Voltage
3	20 KVA, 2200-575/287½ Voltage
2	20 KVA, 2200-122/244 Voltage
7	25 KVA, 2400-120/240 Voltage
1	25 KVA, 2300-115/230 Voltage
1	25 auto KVA, 240-120 Voltage
1	25 KVA, 220-110/220 Voltage
1	25 KVA, 2300-230/460 Voltage
1	30 KVA, 2400-120/240 Voltage
12	37½ KVA, 2400-120/240 Voltage
3	50 KVA, 2400-120/240 Voltage
2	125 KVA, 2200-575 Voltage
1	150 KVA, 2400-120/240 Voltage
1	200 KVA, 2300-230/460 Voltage
	Dry Type
1	250 Watt 220-110 Voltage
1	3 Watt 550-220 3 Voltage
1	15 Watt 250-125 auto Voltage
1	5 Watt 440-110 Voltage

The following is a list of

DAVIS TRANSFORMERS

which we can ship from stock.

1	3	230/460-115/230 dry
40	10	2400-120/240
53	15	2400-120/240
1	50	2400-120/240
1	75	2400-120/240
1	150	240-120/240 dry

The following is a list of

REGULATORS

All these regulators are for use on sixty cycles. The prices indicated include freight to destination in the Eastern Zone.

which we have in our stock that we will thoroughly recondition and ship "without priority."

Kva	Make	Type	Volts	Amps	Form	Phase	Price
34.5	West	S	2400	150		1	$1009.00
34.5	G.E.	IRS	2400	150	P7	1	1009.00
36	G.E.	IRS	2400	150	F4	1	1050.00
24	West	S	2400	100		1	695.00
48	G.E.	IRS	2400	200	F9	1	1213.00
34.5	West	S	2400	150		1	1009.00
30	G.E.	IRT	2400	75	F7	3	1776.00
30	G.E.	IRT	2400	75	F71	3	1776.00
48	West	S	2400	200		1	1165.00
48	G.E.	IRS	2400	200	F7	1	1165.00
23	West	S	2400	100		1	760.00
17.25	G.E.	IRS	2400	75	F7	1	670.00

11.5	G.E.	IRS	2400	50.5	F7	1	575.00
36	G.E.	IRS	2400	150	F7	1	1050.00
24	G.E.	IRS	2400	100	F4	1	725.00
24	G.E.	IRS	2400	100	F4	1	725.00
48	G.E.	IRS	2400	200	F9	1	1213.00
48	G.E.	IRS	2400	200	F9	1	1213.00
24	G.E.	IRS	2400	100	F7	1	725.00
18	G.E.	IRS	2400	75/150	FP72	1	635.00
18	G.E.	IRS	2400	75/150	FP72	1	635.00
12	West	C	2400	50		1	575.00
12	West	C	2400	100		1	575.00
12	West	C	2400	100		1	575.00
12	West	C	2400	50		1	575.00

12	West	C	2400	50		1	575.00
12	West	C	2400	100		1	575.00
12	West	C	2400	100		1	575.00
12	West	C	2400	50		1	575.00
12	West	C	2400	50		1	575.00
12	West	C	2400	50		1	575.00
11½	G.E.	IRS	2300	50/100		1	575.00
24	G.E.	IRS	2400	100/200		1	725.00
24	West	SS	2400	100		1	725.00
24	West	SS	2400	100		1	725.00
24	West	SS	2400	100		1	725.00

All of the Above Units are in Stock as of October 5th and are Offered Subject to Prior Sale. After being Reconditioned They will carry a One Year Guarantee; the Same as New.

DAVIS TRANSFORMER COMPANY, Concord, New Hampshire

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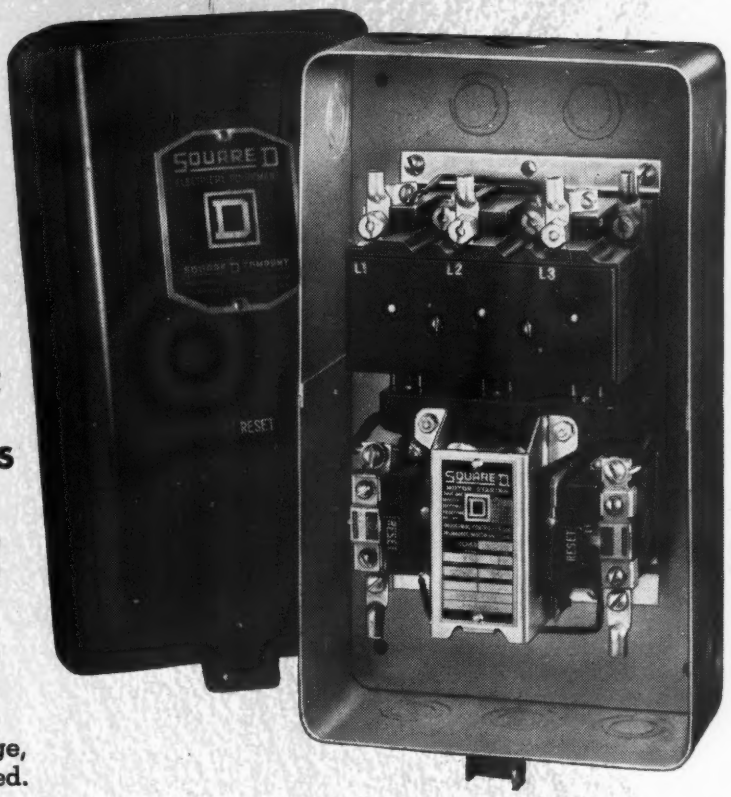
the Right Starter



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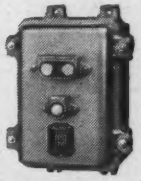
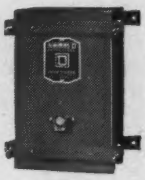
Square D's complete range of types, sizes and enclosures enables you to select exactly the right starter for each job. Manual, Automatic, Line-voltage, Reduced-voltage, Reversing, Multi-speed.



Water-tight enclosure



Dust-tight enclosure

Class II, Group G enclosure

Class I, Group D enclosure

• SIMPLICITY OF DESIGN

Square D starters are simply designed and ruggedly built to give long life under severe operating conditions. Although compact, the ample wiring space and accessible terminals reduce installation time.

• EASY, FAST MAINTENANCE

Accessibility simplifies inspection and saves valuable production time should replacements be necessary. Contacts can be quickly changed without disturbing external connections.

• See your nearby Square D Field Engineer for details or write for Bulletin 8536 which describes line-voltage starters shown above. Square D Company, Industrial Controller Division, 4041 North Richards Street, Milwaukee 12, Wisconsin.

• When you select Square D starters for your industrial customers, you can be confident that they'll back up your judgment in terms of consistent, efficient service. That they are designed and built to "take it" is being doubly proved by their around-the-clock wartime performance in thousands of America's leading industrial plants.

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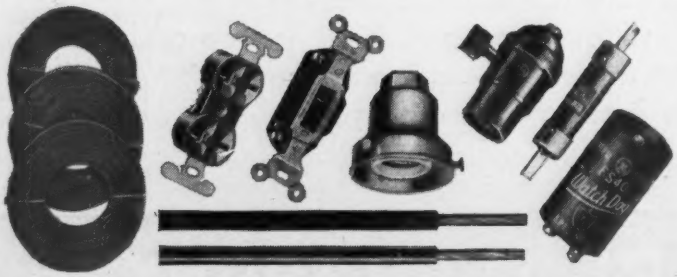

General Electric Co.
Section CDW-1055-8
Appliance and Merchandise Dept.
Bridgeport, Conn.

Sirs: Please send me: ☐ G-E Fiberduct catalog; ☐ G-E Q-Floor Wiring catalog; ☐ Information on G-E Wires and Cables and Wiring Devices.

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